

T H E
H E A V E N S S U R V E Y ' D ,
A N D T H E

T r u e S Y S T E M o f t h e U N I V E R S E

Delineated, so as to form a Curious
A S T R O N O M I C A L I N S T R U M E N T :

E X H I B I T I N G

The *Number, Order, Periods, Aphelions, Perihelions, Nodes, &c.* of all the PRIMARY PLANETS by Inspection :

T O G E T H E R W I T H

An easy and expeditious Method of ascertaining by the same Instrument, and a new Set of Tables, their *Anomalies, Longitudes, Latitudes, Retrogradations, Conjunctions, Elongations, and Distances* at all Times, both *Heliocentric* and *Geocentric* ; that is, as seen from the *Sun* and from the *Earth* ; and also from one another.

In the Course of the Work is met with

A *View of the System from the Earth*, elucidating and explaining the true Causes of the *Directions* and *Retrogradations* of the Planets ; and of the various *Phases* they exhibit to us here : With the Reasons of the *Transits* of *Venus* and *Mercury* over the *Sun* ; the Times when they happen ; --- and an easy Method of delineating the Tracks those Planets take in passing over his *Disk*. --- Also, the remarkable Path which the Planet *Mars* seemed to describe in the Heavens in the year 1762.

The whole adapted to the N E W S T Y L E ;

And constructed in a Manner so easy and natural, as to convey to the *Astronomical Learner* a perfect Knowledge of the *Solar System* at first View.

Addressed to the YOUTH of GREAT BRITAIN and IRELAND.

By the Reverend Mr. TURNER, late of *Magdalen Hall, Oxford* ;

Author of the *View of the Heavens* ; ----- *View of the Earth* ; ----- *Trigonometry rendered Easy and Familiar* ; ----- *System of Gauging* ; ----- *Chronologer Perpetual* ; ----- and a *New Introduction to Book-Keeping*.

Rector of *Comberton* ; Vicar of *Elmley* ; Minister of *Norton* ; and Chaplain to the Right Honourable the Countess Dowager of *Wigton*.

Cœlique Meatus
Describent Radio ; et surgentia Sidera dicent.

VIRG.

L O N D O N ;

Printed for S. CROWDER, at No. 12, Pater-noster-Row ;
MDCCLXXXIII.

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A
VIEW of the HEAVENS:
Being a Short, but Comprehensive,
S Y S T E M
O F
MODERN ASTRONOMY.
EXHIBITING,

- | | |
|---|--|
| <p>I. The Number, Order, Distances, Magnitudes, and Periods of all the Planets and their several Moons, composing our System, which the Learning of the present Age esteems as so many Worlds full of Inhabitants.</p> <p>II. The length of the Day and Year, with the Variety of the Seasons in each Planet; and also the Phenomena of the Heavens to the Inhabitants thereof.</p> <p>III. Some Account of the Comets, their Number, Period, and Appearances; and also the Directions of their fiery Trains thro' the Heavens; with probable Conjectures of the Uses of those amazing Bodies.</p> <p>IV. The Number, Magnitude, and Distances of the Fixed Stars; with their Divisions into Signs, Catalogues, and Constellations.</p> <p>V. The true Figure of the Planets' Orbits, with the Nature of the Motions in them; their</p> | <p>Aphelions, Perihelions, Eccentricities, Nodes, &c. &c.</p> <p>VI. The Inequality in the Length of the Natural Day, commonly called the Equation of Time.</p> <p>VII. The Power that retains the Earth and Planets in their Orbits.</p> <p>VIII. The direct and retrograde Motions of all the Planets; as also, the Reasons why they sometimes appear stationary, or not to move at all.</p> <p>IX. The Nature and Causes of Eclipses, both of the Sun and Moon; with an easy and expeditious Method of calculating the Eclipses which will happen in any Year.</p> <p>X. The Description and Use of a curious Astronomical Clock, which will shew the Hour of the Night by the Stars.</p> |
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TO WHICH IS ADDED,
The Use of the CÆLESTIAL GLOBE:
WITH

Its Application to a Number of very interesting PROBLEMS. Concluding with some curious Phenomena upon the SUN and MOON exhibited in a darkened Room; and a few select PARADOXES, intended to excite the Attention of the Learner.

The whole illustrated with Copper-plates of the System, the Sun, Moon, Eclipses, &c. and disposed in so easy and natural a Manner, as to be understood in a few Days.

THE SECOND EDITION, WITH MANY ADDITIONS AND IMPROVEMENTS.

By the Rev. Mr. TURNER, of *Magdalen-Hall, Oxford*;

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The WORLDS were framed by the WORD of GOD.

PAUL.

L O N D O N:

Printed for S. CROWDER, at No. 12, Pater-noster-Row, MDCCLXXXIII.

T O T H E
R E A D E R.

ASTRONOMY in all Ages has been cultivated not only by Men of the greatest *Genius*, but those of the highest *Honours*.—*Kings* as well as *Philosophers* have studied the Revolutions of the glowing Worlds above, and made them useful to us, by measuring out our *Dates* and *Time* here on Earth.

The vast Advantages derived to Mankind from thence, together with the Pleasures resulting from this *Heavenly Science*, induced me to draw up this new Work for the Youth of these Kingdoms; which, as it is now become a Science so necessary in *civil* and *sacred* Life, and of which every Person (who would be a Scholar) should have some Knowledge, I have attempted in a Manner as easy and engaging as possibly I could.

With this View I have supposed the *young Astronomer* transferred from the *Earth* to the *Sun*, where he may the better behold the several Worlds wheel round him, and observe their various *Distances*, *Periods*, *Dimensions*, *Inclinations* of their *Axes* and *Orbits*, *Aphelions*, *Perihelions*, and *Nodes*; and have also supposed him to traverse the *System*, and to have actually taken those several *Measures* and *Dimensions*, and noted them down in a Table.

Next, I have directed him how to delineate these Observations, and afterwards to fit up his Projection into a *Curious Astronomical Instrument*, by which he may easily calculate, at all Times, the Places of all the *Primary Planets*, and exhibit their Situations as naturally as in the Heavens themselves.

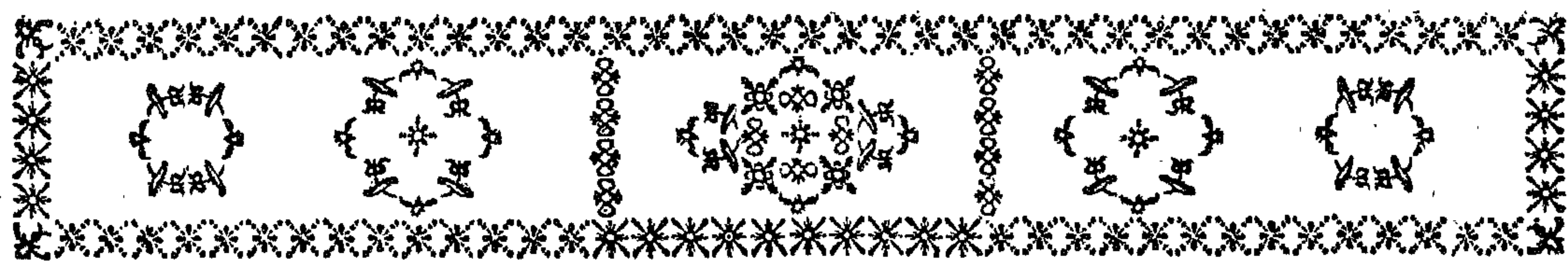
To

To make it still more evident, I have annexed a Variety of *Examples*—some for each Planet; which, being once perused, he cannot fail of understanding the usual Method of making these Calculations by *Triangles*, as he will immediately see on the *Instrument* how the Lines are situate in the Heavens;——what *Sides* and *Angles* are given, and what required to be found by *Trigonometrical Calculation*.

He has in the last Place, a new *Sett of Tables* for finding the *mean Anomalies*, and Equation Tables for each Planet, for reducing them to the *true Anomalies*.—Also, a *Table* is added of *Inclinations*, or *Heliocentric Latitudes* of the Planets, depending on their Distances from their *Nodes*: And to make the Work more complete—*all these Tables are adjusted to the NEW STYLE*.

That the Youth may receive that *Pleasure* and *Advantage* from the Perusal of this *Work* which was intended them by its Publication, is the sincere Wish of

The A U T H O R.



T H E

H E A V E N S

S U R V E Y E D.

AS Nothing can give us higher, or more noble *Ideas* of G O D, the great Former of the Universe, than — to contemplate the Planetary Worlds above; — to survey the astonishing Spaces through which they rowl; — to reflect on the Vastness of their Bulks; — the amazing Velocity of their Motions; — and above all, the exact Regularity and Harmony of their Periods: — so I flatter myself, that any rational Scheme tendered to the World, with a Design of facilitating Enquiries of such a sublime and interesting Nature, cannot but be pleasing to every thoughtful and ingenuous Mind.

And, though it be very possible to give the Learner a Knowledge of the Wonders and Immensity of that Heavenly Fabric from this Earth on which he now resides; yet as it would be more easy and natural for him to behold it from the *Center*, round which all the Planets move, he will give me Leave to conduct him thither, and point out to him the wonderful Construction and *Phænomena* of the System from that Point of View*.

* As the young Astronomer hath pointed out to him here, the Order and Harmony of the System from the *Sun*, the Center of it; so at Page the 24th, the Diversity of the Motions and Aspects of the several Planets are exhibited to him from the *Earth*, the Place of his present Residence.

On his Arrival *there*, he will find the *Sun*, an huge Globe of Light, plac'd in the Midst of immense Space, with Six opaque spherical Bodies moving round him as their Center; which at different Distances, and in different Periods of Time, perform their Revolutions all the same Way, *i.e.* towards the *Left-hand*, in the Order following.

First, he will see *Mercury* the nearest of all the *Planets*, moving the quickest, and describing the smallest Orbit round the *Sun*.—Next, he will see *Venus*, which, as she is further off, takes a larger Circuit, and a longer Time to compleat it.—Beyond her he will behold our *Earth* moving in her Orb not quite so fast as *Venus*.—Next her advances *Mars*, but revolves much slower.—Then comes, at a vast Distance beyond him, the Planet *Jupiter*, slower still.—And last of all, he sees *Saturn*, as it were come *creeping* round his Orb *.

At a vast Distance beyond *Saturn*, he will observe the azure Sphere of the *fixed Stars*, sparkling all over with Lights of different Lustres and Magnitudes. These he will find, (contrary to the *Planets*) never to vary their Places, but remain always in the same Position. And as it is impossible to distinguish each single Star by a particular Name, *Astronomers* have agreed to suppose a Number of them lying near each other, to be covered with the Image or Picture of some Animal, or other Thing.—That *Round* of the *starry Arch* opposite to the Orbs of the *Planets*, is divided into 12 Images, whose Names are, *Aries—Taurus—Gemini—Cancer—Leo—Virgo—Libra—Scorpio—Sagittarius—Capricornus—Aquarius—Pisces*. This Space is called the *Zodiac*. It is supposed to be divided into 360 equal Parts, called Degrees: *Thirty* of which belong to each Image.

☛ The *Earth's Orbit* passes exactly opposite the Middle of these 12 Signs or Pictures.—And a Plane level with the *Earth's Orbit* extended from the *Sun* to the fixed Stars is called the *Plane of the Ecliptic*†: and this *Astronomers* make the standard to which the Planes of the other *Planets* (which is very little) are found to incline.

* Besides these six *Primary Planets*, which continually circulate round the *Sun* as the Center of their Motion, there are several *Smaller* which circulate round them, and are carried with them in their Journeys round their Orbits. These are called *Satellites*, or *Moons*, and are ten in Number: of which one well known, belongs to our *Earth*. Four attend *Jupiter*; and five wait upon *Saturn*, who has also a bright *Ring* surrounding his Body edge-wise, but no where touches it. These *Moons* (which are a *Secondary kind of Planets*) are too small to be seen by an *Astronomer* at the *Sun*, or even at the *Earth* when it is much nearer them—without a *Telescope*. The *Tracts* too, which they describe in the Heavens, are very complicated; some forming *Curves* with *Loops* in them; and others *Lines* difficult for a Learner to conceive immediately; for which Reason I have reserved the *Theory* of their Revolutions and Method of calculating their Positions, with respect to their *Primaries*, for a future Part of this Work.

† Because no *Planets* are eclipsed, or hid by one another from the *Sun*, but when they are in that *Plane*, and exactly in the same Line continued to the Stars.

The several *Periods* of the Planets round the *Sun*, if accurately observed, and reduced to our *Time* here, as they depart from any *fixed Star* and return to it again, will be found nearly as under.

		Days	Hours	Min.	
Mercury	} revolves about the Sun in the Space of }	87	-	23	- 16
Venus		224	-	16	- 49
Earth		365	-	6	- 9
Mars		686	-	23	- 27
Jupiter		4332	-	12	- 20
Saturn		10759	-	6	- 36

which is the
Length of
the Year at
that Planet:

☛ *Mercury* and *Venus* are called *inferior Planets*, because they are lower or nearer the *Sun* than the *Earth* is; but *Mars*, *Jupiter*, and *Saturn* are called *superior Planets*, because they move beyond the *Earth*, and are higher in the *System*.

The *Planets* he will observe to revolve the same *Way*, and nearly round the middle or *equatorial* Parts of the *Sun*, with a very small *Inclination* to one another. For if he makes the *Earth's Orbit* the *Standard* of the other *Orbits*, he will observe that they have one Half a little *above*, and the other Half a little below it, cutting it in two opposite Parts exactly.—The *Inclinations* of these *Orbits* to the Plane of the *Earth's Orbit* he will find to be nearly thus.

		Deg.	Min.
The Orbit of	Mercury	<div style="display: inline-block; vertical-align: middle; font-size: 4em; line-height: 1;"> { </div> inclines to the <i>Earth's</i> <i>Orbit</i> , or makes an Angle with it of about	6 - 54
	Venus		3 - 23
	Earth		— - —
	Mars		1 - 51
	Jupiter		1 - 22
	Saturn		2 - 30

The Points where the several *Orbits* of the *Planets* cut or cross the Plane of the *Earth's Orbit*, either in ascending above it, or descending below it, are called the *Nodes* of those *Planets*.—That Point where the Planet ascends above the *Orbit* of the *Earth* is called the *North* or *Ascending Node*; and the other Point where the Planet descends below it, is called the *Southern* or *Descending Node*.—These *Nodes* or apparent *Intersections* of the *Orbits* of the *Planets* with that of the *Earth's Orb*, (if referred to the *Ecliptic* at the *Stars*) will be found at this *Time* to be nearly in the following Places.

		Deg.	Min.	
The North or Ascending Node of	Mercury	<div style="display: inline-block; vertical-align: middle; font-size: 4em; line-height: 1;"> { </div> is in	15 - 45	Taurus
	Venus		14 - 34	Gemini
	Earth		— - —	—
	Mars		18 - 9	Taurus
	Jupiter		8 - 32	Cancer
	Saturn		21 - 26	Cancer

☛ The *South* or *Descending Node* is in the Sign, Degree, and Minute opposite the ascending one.

Whilst

6 THE HEAVENS SURVEYED.

Whilst the Observer views the several *Planets* revolving round the Sun in their annual Courses, he will perceive that each has a Rotation upon its own Axis, to cause *Day* and *Night* at that Planet.—The Times of their several Rotations are as follow.

		D.	H.	Min.	
Mercury	} turns upon its Axis in about	0	6	0	} which is the Length of the Day to the Inha- tants there.
Venus		0	23	0	
Earth		0	23	56	
Mars		1	0	40	
Jupiter		0	9	56	
Saturn		29	10	1	

☞ The Earth turns upon her Axis in respect to the *fixed Stars* in 23 Hours 56 Minutes, but in respect to the *Sun* in 24 Hours *.

The *Axis* of every *Planet* he will observe to lean or incline to the Plane of its own Orbit, from whence will necessarily arise a Variety of Seasons in those Planets. The *Axes* of the *Planets* always keep in the same Position † or Parallel round their Orbits. Their *Inclinations* are as here set down.

		Deg.	Min.
Mercury's	} Axis inclines to the Plane of its Orbit	—	—
Venus's		very little	
Earth's		23	29
Mars's		very little	
Jupiter's		very little	
Saturn's		30	0

The *Velocities* of the *Planets*, or Spaces of their Orbs passed thro' in a given Time, he will discover to be *greater* in the Planets nearer the *Sun*, and *less* in those further off. Their Motions in an Hour are as here expressed.

		Miles.	
Mercury	} moves in one Hour about	100.000	} and so far are the Inhabi- tants of that Planet carried every Hour, without being sensible of that rapid Motion.
Venus		70.000	
Earth		56.000	
Mars		45.000	
Jupiter		24.000	
Saturn		18.000	

From a late Observation, if it may be depended on, the *Velocities* of the Planets are one sixth Part greater still.

* The Rotations of *Mercury* and *Saturn* upon their Axes were observed by the Astronomer *Rheita*; and *Bianchini* makes the Rotation of *Venus* to be 24^d 8^h, and the *Inclination* of her Axis 75°.

† See my *Modern Geography* or *Modern Astronomy*, where the Earth, with the proper *Inclination* of its *Axis*, is delineated in four various Parts of its Orbit.

The Spectator, whilst he continues at the *Sun*, will further observe that the Planets in their Revolutions, when they arrive to a certain Part of their Orbits will appear a little larger, and when they come to the opposite Part will appear a little smaller. He will also perceive that when they look smaller their Motion is something slower; but as they begin to appear bigger their Motion grows a little swifter. Hence he will be naturally led to infer, that they must sometimes be a little nearer to him, and at other Times a little further from him; and, consequently, that their Orbits cannot be *perfectly circular*, but a little *elliptical*, or *oval*.—When any Planet is at its greatest Distance, it is said to be in *Aphelion* (or from the Sun); when at its least Distance, it is said to be in *Perihelion* (or near the Sun)*.—The exact Places in their Orbits where the several Planets are in their *Aphelions*, or greatest Distances from the *Sun*, the Observer will find, at this Time, to be when they appear against, or in the following *Signs* and *Degrees* of the *Ecliptic*.

		Deg.	Min.
Mercury's	} <i>Aphelion Point</i> is in or about	Sagittarius	13 - 45
Venus's		Aquarius	7 - 37
Earth's		Capricorn	8 - 57
Mars's		Virgo	1 - 55
Jupiter's		Libra	10 - 58
Saturn's		Capricorn	0 - 6

Their *Perihelion Points* are in the opposite *Sign*, *Degree*, and *Minute*, exactly.

Now, if the Observer be supposed to advance from the *Sun* to each Planet when in *Aphelion*, and again when in *Perihelion*, and accurately measure their several Distances from the *Sun* to those Points of their Orbits, he will find them to be nearly as under†.

Mercury's	} Aphelion, or greatest Dis- tance from the Sun	38.455.700	} Perihelion, or least Dis- tance from the Sun	25.544.300
Venus's		59.418.770		58.581.230
Earth's		82.368.900		79.631.100
Mars's		134.421.000		111.579.000
Jupiter's		444.290.500		403.709.500
Saturn's		821.307.000		732.693.000

* At the *Sun*, the Planets appear but small: for *Mercury's* diameter does not subtend an Angle of more than 20"; nor *Venus's* of more than 30" The *Earth* appears nearly the same as *Venus* *Mars's* Diameter appears about 5". *Jupiter's* about 40"; and *Saturn's* about 20". The *Satellites* or *Moons* of *Jupiter* and *Saturn*, are not visible there.

† An Observer of the Planets *there*, might gain some Idea of their *relative Distances* and *Magnitudes*, but could not obtain their real Ones; because no Method offers itself at that Station of ascer-
taining their *Parallax*: Nay, the Planets seen from thence have *no Parallax* at all.

When the *Planets* are in the Middle of their Orbs, between the *Aphelion* and *Perihelion* Points,—they are said to be at a *mean Distance* from the *Sun*: which Distances of all the Planets will be found nearly these following.

Mercury's	Mean or Middle Distance from the Sun is about	32	Millions of Miles.
Venus's		59	
Earth's		81	
Mars's		123	
Jupiter's		424	
Saturn's		777	

The Distance of the nearest of the *fixed Stars* he will find to be almost 20 Millions of Millions of Miles from the *Sun*, which is more than 20.000 Times farther than *Saturn**.

If the *Diameters* of the *Planets* be taken by the Surveyor as he passes along in measuring the Distances, they will be found to be nearly as under.

The Sun's	Diameter is about	763.000	Miles.
Mercury's		2.460	
Venus's		7.906	
Earth's		7.964	
Mars's		4.444	
Jupiter's		81.155	
Saturn's		67.870	

☞ The Diameters multiplied by 3.141 will give their *Circumferences*.

At the different *Planets* he will observe the *Sun* of different Magnitudes; bigger to the nearest, and less to those farther off. The *Solar Light* is also much greater to the nearer Planets than to those situate higher in the System.

At	Mercury	the Sun's Diameter appears almost	2 Feet $\frac{3}{4}$	and the Light there is about	7 Times greater	than at the Earth.
	Venus		1 Foot $\frac{1}{2}$		Twice as great	
	Earth		1 Foot			
	Mars		9 Inches		Half as great	
	Jupiter		2 Inches $\frac{1}{4}$		27 Times less	
	Saturn		1 Inch $\frac{1}{4}$		90 Times less	

At the *fixed Stars* the *Solar Disk* dwindles into a lucid *Point*, and seems only a Star in the opposite Part of Heaven; and all our Planets are totally invisible there.

☞ The *fixed Stars*, in all Probability, are so many Suns, having Planets surrounding them, as our Sun has.

As the young *Astronomer* traverses the System, he will observe that all the Planets cast a *Shadow* behind them directly opposite the Sun, which Shadow terminates in a Point before it reaches the Orbit of its surrounding Planet; But the *Moon* revolving round our *Earth*, and those of *Jupiter* and *Saturn*, he will find to run sometimes into the Shadows of their Planets, and by that means be deprived of the Sun's Light. At that Time they become obscure, and are said to suffer an Eclipse.

The Nature of *Eclipses* of the *Earth* and *Moon* are fully explained in the *System of Modern Astronomy*.

* These are the Distances of the Planets usually received by Astronomers; but if the late *Transits* of *Venus* over the *Sun* may be depended on, the Distances will be found to be about one sixth Part greater; that is, those will exceed these about as much as *Statute Miles* exceed *Computed Miles*: But Projections of the System made from either Measure will be equally exact. The Method of calculating the Distances both Ways may be seen in my *Trigonometry*.

The *Sun* he will discover to be a huge Sphere, of most wonderful and exquisite Construction, which, by repeated Circumgyrations on its Axis, projects from its Surface fine subtile Particles of Matter (usually called *Æther*) to the most distant Parts of the Universe.—These Particles by their amazing Velocity constitute not only our *Light*, but are perhaps the *Primum Mobile*,—the Spring of Motion and Action of the whole System. Their Motion is inconceivably rapid, being not less than 10 Millions of Miles *per Minute*; so that they reach *Mercury* in 3', *Venus* in 5', the *Earth* in 8', *Mars* in 12', *Jupiter* in 42', *Saturn* in 77';—but do not arrive at the *nearest fixed Star* in less than 3 or 4 Years, and to Stars of the *second Magnitude* not in less than 6 or 7 Years: And so long is *Light* descending from those Stars to us.—Hence we may reflect how very different the Places of the *Sun*, *Planets*, and *fixed Stars* are in the Heavens, from those they appear in from hence.

The Observer, as he leaves the Regions of the Sun and advances toward the Planets, will behold the whole Space he passes through to be *obscure* and *dusky*, unless the aforesaid revolving Bodies, which appear very bright, by reflecting the *Solar Light* back to his Eye.—He will also perceive it grow very *cold* as he recedes from the Sun, because the *Light* is so subtile as to pervade and pass thro' him with little or no Resistance: But as he enters the *Atmosphere* of any Planet, and becomes invested with the grosser Parts of it, he will find it begin to grow *warm*, which Warmth will continue to encrease upon him, till he comes down to the Surface of the Planet, where he will experience the greatest Heat of all.

The *Heat* and *Cold* at any Planet he will discover to arise—not so much from the Planet's Nearness to or Distance from the *Sun*, as from the Nature of its *Soil* and the Density of its *Atmosphere*.—Hence it happens that, by the Rarity of it at *Mercury*, and the Density of it at *Saturn*, the Inhabitants of the former do not complain of the *Intensity* of the *Heat*, nor those at the latter lament the *Severity* of their *Cold*; but as regular Temperament is observed and kept up at each Planet as upon the *Earth* where we live. This makes them *all* fit Places for Habitation, and as comfortable and agreeable in their Variety of Seasons, of *Days*, and *Years*, as ours here.

Besides these Wonders of the Heavens, there are many others not yet come to his Inspection*.—To survey them *all* would be a Work next to impossible; since they are like the *Divine Contriver*, infinite perhaps, and, at present, past our finding out. But these, already beheld and discovered, are enough to convince us, not only of the *Existence* of G O D, but also, of his *Wisdom*, *Power*, and *Goodness*; and to make us break out and confess, in the Language of the Psalmist, that———*There is no Work like thy Work—for thou art great and doest wonderful Things!*

* As (1) What the Power is, which retains the Planets in their Orbits; and keeps the Inhabitants upon their Surfaces as they rowl round their *Axes*. (2) What the Causes of those Laws are by which that Power acts through all Parts of the System. (3) Whether the same Number of Revolutions of a Planet does not determine the Age of the Inhabitants there. (4) Whether those that live at *Mercury* are not 4 Times more active than we at the *Earth*; and whether our Ideas and Actions here are not 30 Times quicker than their's at *Saturn*. (5) Whether a Child born at the same Moment on each Planet,—that at *Mercury* will not be 4 Years old (of our Time);—that at *Venus* 1 Year 8 Months;—that at *Mars* Half a Year;—that at *Jupiter* 1 Month;—that at *Saturn* only 12 Days, when that upon our *Earth* shall have compleated 1 Year. These, with Observations relative to the Dimensions of the Inhabitants of each Planet, may be considered in a future Work.

10 THE HEAVENS SURVEYED.

Here follows A TABLE, in which the foregoing *Proportions* and *Properties* of the *Primary PLANETS* are brought to one View.

Planets Names. Their <i>Revolutions</i> .	Mercury. 87 ^d 23 ^h 16'	Venus. 224 ^d 16 ^h 49'	Earth. 365 ^d 6 ^h 9'	Mars. 686 ^d 23 ^h 27'	Jupiter. 4332 ^d 12 ^h 20'	Saturn 10759 ^d 6 ^h 26'
<i>Inclination</i> of their Orbits to Earth's.	6° 54'	3° 24'	the Standard	1° 52'	1° 20'	2° 30'
Place of the <i>As-</i> <i>cending Node</i> , the <i>Descending</i> op- posite.	♈ 15° 45'	♊ 14° 34'	* * *	♈ 18° 9'	♊ 8° 32'	♊ 21° 26'
Turn upon their <i>Axes</i> .	0 ^d 6 ^h 0'	0 ^d 23 ^h 0'	0 ^d 23 ^h 56'	1 ^d 0 ^h 40'	0 ^d 9 ^h 56'	29 ^d 10 ^h 1'
<i>Inclination</i> of their <i>Axes</i> to their <i>Orbits</i>	* * *	very little†	23° 29'	very little	very little	30° 0'
Place of the <i>Aphe-</i> <i>lions</i> , the <i>Perihe-</i> <i>lions</i> opposite.	♏ 13° 45'	♍ 7° 37'	♏ 8° 57'	♏ 1° 55'	♏ 10° 58'	♏ 0° 6'
Greatest <i>Distance</i> from the Sun.	38.455.700	59.418.770	82.368.900	134.421.000	444.290.500	821.307.000
Least <i>Distance</i> from the Sun.	25.544.300	58.581.230	79.631.100	111.579.000	403.709.500	732.693.000
Mean <i>Distance</i> .	32.000.000	59.000.000	81.000.000	123.000.000	424.000.000	777.000.000
Their <i>Diameters</i> in Miles.	2.460 *	7.906	7.964	4.444	81.155	67.870
<i>Motion</i> in 1 Hour.	100.000	70.000	56.000	45.000	24.000	18.000
Proportion of <i>Light</i> and <i>Heat</i> .	7 Times greater.	2 Times greater.	at the Earth 1	$\frac{1}{2}$ as much	27 Times less.	90 Times less.

The *mean Distances* of the Planets from the Sun, their *Diameters*, and *hourly Motion* in their Orbits, as deduced from the late *Transit of Venus* over the Solar Disk, are as under; and are about one sixth greater than those usually received.

New Distances.	36.841.468	68.891.486	95.173.000	145.014.148	494.990.976	907.956.130
Diameters.	3.100	9.360	⊙ 843.760 ⊖ 7.970	5.150	94.100	77.990
Motion in 1 Hour.	109.699	80.295	68.243	55.289	29.083	22.101

The *Distance* of the nearest *fixed Star* is almost 20 Millions of Millions of Miles from the Sun; which is above 20.000 Times farther than *Saturn*. Stars of the 2d Size are almost as far again.

The Observer in his *Tour* thro' the *System* having made these Observations, and taken these Dimensions, and noted them down in a Table, as a Surveyor does the Angles and Sides of a Piece of Land in his Field-book, he may proceed to delineate the Survey in the following Manner.

† *Bianchini* supposes the Axis of *Venus* to incline 75 Degrees; that she revolves on her Axis in 24 Days 8 Hours; consequently has only 9 Days and $\frac{1}{4}$ in her Year.

* The *Light* and *Heat* at the Sun is about 45.000 Times greater than at the *Earth*.—His Diameter is 763.000 Miles.—The *Inclination* of his Axis about 8 Degrees, and his Revolution round it is performed in 25 Days and $\frac{1}{4}$.

A

DELINEATION of the HEAVENS,

ACCORDING TO

The foregoing SURVEY.

THIS Delineation will consist of two Parts, a *smaller* and a *larger*; (see the two Plates at the Beginning of the Book)—The smaller Part has several Circles described upon it.—The *Center* represents the *Sun*.—The first Circle next him, the Orb of *Mercury*;—the second, *Venus*;—third, our *Earth*;—fourth, *Mars*;—fifth, *Jupiter*;—sixth, *Saturn*;—and the next Circle (which is double) beyond *Saturn*, represents the *Ecliptic Line* at the *fixed Stars*, divided into the 12 Signs;—and the Circle bounding it is also divided into 12 Signs, and on this is accounted the *Earth's Anomaly*.—On the other, or larger Part, is described another double Circle, which is divided into 12 Signs. This Circle is used in reckoning the *Anomaly* of any of the Planets.—This being premised, the Reader may proceed to the *Construction* or *Delineation* as follows.

First, make a *Scale* of *equal Parts*, of any Size you please;—then taking off about 850 of those Parts, describe the *Ecliptic Line*, and divide it into 12 equal Parts, and each Part into 30 more; write therein the *Names* of the *Signs* and their *Characters*, as you see in the smaller Plate.—Then you may proceed to delineate the Orbs of the *Planets* in the following Manner.—Look in the Table before-going, for the *Aphelion* Place (first for *Saturn*) and you will find it to be at $6^{\circ} 6'$ of *Capricorn*.—Find this Place on the *Ecliptic*, and draw a Line from it (with a Black-lead Pencil) through the Center to the opposite Sign and Degree.—Then look also, in the same Table, for the *greatest Distance* of *Saturn*, which take off the same Scale of equal Parts, and set it from the Center towards the *Aphelion* Point, where make a Dot, and write *Aphelion*.—Take also the *least Distance* off the Scale, and set it from the Center towards the *Perihelion* Point, and there make another Dot, and write *Perihelion*.—Then finding the *Middle*, between those Distances, describe thereon a Circle, which will express the *Orbit of Saturn*.—In the Table look the Place of *Saturn's Node*, and having found it in your *Ecliptic*, lay a Ruler from the Center to that

D

Part,

Part, and where it intersects (or cuts) the Orb of Saturn make a Dot, and inscribe against it N. & for *North Node*. In the opposite Part of the Orbit make another Dot, and insert there S. & for *South Node*.—— In the same Manner you may proceed to project the *Orbs*, with the *Aphelions*, *Perihelions*, and *Nodes* of all the *primary Planets*: which being performed, you must then describe a Circle a little beyond the *Ecliptic*, and right against the *Aphelion Point* of the *Earth* begin to divide it into 12 Signs and Degrees, as the *Ecliptic* is; and number it as you see done there.—— On this Line is always found the *Earth's Anomaly*.

Next, upon the *larger Part*, describe another Circle, something wider than that of the *Earth's Anomaly*, and, beginning at any Part, proceed to divide it in every respect as the *Earth's* is.—— On this Circle the *Anomaly* of the *Planets* is always found.

Lastly, take the larger Part, cut it round close to the Circle, and paste it upon a strong circular Board of the same Size: This Board should have three small Feet on the under Side, about two Inches high, to raise it free from the Table it shall be placed on when used.—The smaller Part must in like Manner be cut round, and pasted upon a very thin Piece of Board (that will not warp) which just fits it. Then the Centers of both Parts are to be connected by a large Pin or Wire, in such Manner, that the upper Part may turn easily upon the under.

To the Pin, which stands about one Inch high, are to be fixed three *fine Threads*, with a small Plummet or Ball at the End of each, to keep them strait when extended from the Center; and a small Bead may also be put upon each Thread.—Upon the *Top* of the *Pin* may be affixed a large *Bead*, which will serve as well for Ornament, as represent the *Sun* in the Center of all the Planets.

Thus is the Projection finished, representing the true Proportion and Symmetry of the Heavens; and becomes, thus fitted up, a *curious Astronomical Instrument*, by which the Places and Situation of all the Planetary Worlds, with respect to one another, may be determined at any Time, with great Exactness and little Trouble.

Some of the many Uses of this Instrument immediately follow

THE

T H E
U S E

O F T H I S

Cælestial PROJECTION or INSTRUMENT.

I. To ^{Rectify} Rectify the Instrument.

FIRST, bring the *Aphelion Point* of the Planet, whose Place you want to find in the Heavens, on the moveable Part, to the Beginning of the Divisions on the Circle in the fixed Part, and let it remain there.

II. To find the *Anomalies* of any of the Planets.

Turn to the *Tables* at the End of the Book, and write out the *Anomalies* of the *Earth* and of the *Planet*, answering to the *Year, Month, Day, and Hour* proposed. These added up severally will be the *mean Anomalies** of each for that Time, remembering in *Leap Year*, after *February*, to add the Motion of one Day more.

With these *mean Anomalies* enter the *Tables* of their *Equations*, with the *Sign* at the *Top* (if less than six Signs), and the *Degree* in the first Column on the left Hand descending:——But if the *Anomaly* be six Signs or more, look the *Sign* at the *Bottom* of the Table, and the *Degree* on the right Hand *ascending*; and in the common Angle, or Place of Meeting, is the Equation; which, according to the Title, *added to*, or *subtracted* from the *mean Anomaly*, will give the *true Anomaly*, or real Distance of the *Earth* and Planet from their *Aphelions* at that Time.

III. To find the *Heliocentric Place* of any of the Planets.

Lay one of the Threads upon the *Anomaly* of the Planet found in the *outer Circle*; and also a Thread to the *Anomaly* of the *Earth* found in the *second Circle*, so will these Threads severally cut the *Heliocentric Places* of the *Earth* and Planet (*i. e.* the Places as seen from the *Sun* the Center of the System) in the *Ecliptic*; and the Places where the Threads cut their Orbits will be the *true Places* of those two Bodies, and the exact Situation of them in the Heavens at that Time. And if a small *Bead*, which should be upon each Thread, be brought to each of these Intersections, they will truly represent the Planets themselves.

* The *mean Anomaly* of a Planet is its Distance from the *Aphelion Point*, supposing the Orb in which it revolves to be *circular*. But its *true Anomaly* is its Distance according to an *Ellipsis*, which is the true Figure (more or less) of all their Orbits.

IV. To find the *Geocentric Place* of any *Planet*, *i. e.* its *Place* in the *Ecliptic* as seen from the *Earth*.

Lay the Edge of the Scale, or Index, you projected the Instrument by, from the *Earth* in its Orb to the *Planet* in his; then bring the third Thread so as to lie *parallel* to the Index; remembering to lay it ever from the Center towards the Planet; so will the Thread cut the *Ecliptic* in the Planet's *Geocentric Place*, and shew the Sign, Degree, and Minute of the *Ecliptic* it then possesses as seen from *hence* *.

V. To find the *Heliocentric Latitude* of a *Planet*, *i. e.* its *Latitude* as seen from the *Sun*.

At the same Time as the Bead lies upon the Orbit of the Planet, you may easily discover his Distance from the *nearest Node*; and by knowing the Planet's greatest Latitude, or Inclination, (which is always when he is in the *middle*, between the *Nodes*, and is express'd in the foregoing Table) you may nearly estimate his Latitude at that Time.

If the Bead or Thread lie on the right Hand the *N. Node*, the Planet has North Latitude; and lies *above* the Plane of the Earth's Orbit, so much as is his Latitude:—If the Thread lie on the right Hand of the *S. Node*, the Planet has South Latitude; and is *below* the *Ecliptic*, or Plane of the Earth's Orbit.

✎ But to discover the *Latitude* more exact; count the Planet's Distance from the *nearest Node* in *Degrees*; with that Distance enter the Table of *Inclinations*, &c. at the End of the Book; and right against it, under the Planet, you have the Planet's *true Heliocentric Latitude* at that Time.

* The Orb of the *fixed Stars* being delineated near to the Orbit of *Saturn*, whereas it should have been placed (had there been Room) above 20.000 Times further off, the *Index* when laid from the *Earth* to the *Planet*, cannot cut the *Ecliptic* in the Place it would do if it was removed to its true Distance. — But as the Distance of the *Stars* is so immensely great, the *Semidiameter* of the *Earth's* Orbit dwindles as it were into a *Point*, consequently, a *Line* extended from the *Sun*, *parallel* to the *Index*, will fall upon the same Point or Part of the *Ecliptic* that the *Index* would do, if extended thither.

VI. To find the *Geocentric Latitude* of a *Planet*, *i. e.* his *Latitude* as seen from the *Earth*.

The *Latitude* of a *Planet* as seen from the *Sun*, is very different from that seen from the *Earth*; because the *Earth* in moving round her *Orbit* must be sometimes nearer, sometimes farther off the *Planet*, than the *Sun* is; But having found the *Latitude* as seen from the *Sun* (by the former Proposition), you may find his *Latitude* as seen from the *Earth* in the following Manner.
 —Measure with the *Index* the *Planet's* Distance (in Millions of Miles) from the *Sun* and from the *Earth*; then say by the Rule of Three Inverse,

As the *Planet's* Distance from the *Sun*,
 Is to his *Latitude* seen from thence;
 So is his Distance from the *Earth*,
 To his *Latitude* seen at the *Earth*.

Hence it always follows, that when the *Earth* is nearer the *Planet* than the *Sun* is, the *Geocentric Latitude* will be greater than the *Heliocentric*: But when the *Earth* is farther off than the *Sun* from the *Planet*, the *Geocentric Latitude* will be less than the *Heliocentric*.

VII. To find when any of the *Primary Planets* are in *Aphelion* or *Perihelion*.

Having collected from the *Tables* the *Anomalies* for the *Time* proposed, if the Sum amount to 0 Sign, 0 Deg. &c. the *Planet* is then in *Aphelion*, or at its greatest Distance from the *Sun*, and its Motion is then slowest: But if the Sum be exactly 6 Signs, it is then in *Perihelion*; is nearest the *Sun*, and its Motion is now at the fastest.

☞ This is seen immediately upon the Instrument.

VIII. To find when a *Planet* is in *Apogee* or *Perigee*.

If the *Threads* when laid--the one to the *Earth's Anomaly*, and the other to the *Planet's Anomaly*, lie in a right Line on different Sides the *Sun*,--the *Planet* is then in *Apogee*, or at his greatest Distance from the *Earth*:---But if the *Threads* lie one upon another, on the same Side the *Sun*, the *Planet* is then in *Perigee*, or nearest the *Earth*.

IX. To find when a *Planet* is at its greatest *Elongation*, or *Digression* from the *Sun*, on either Side of him.

In the Superior Planets, *Saturn*, *Jupiter*, and *Mars*, this is always when they are *opposite* the *Sun*, or 180 Degrees distant from the Sign and Degree he is then in. — But in the Inferior Planets, *Venus* and *Mercury*, it is when the *Index* being laid from the Earth to the Planet does no where cut the Planet's Orbit, but exactly touches it, like a *Tangent Line*.

X. To know when a *Planet* is *Direct*, *Stationary*, or *Retrograde* in the Heavens.

(1.) For the Superior Planets.

When the *Index* is laid from the *Earth's* Place in her Orbit, to *Saturn*, *Jupiter*, or *Mars* in their's, if the *Index* does not cut the *Earth's* Orbit, but becomes a *Tangent Line* to it, then the Earth is at its greatest *Elongation* seen from that Planet; and the Planet, about that Time, seen from the Earth, becomes *stationary*. And if the Earth be advancing towards the Planet on the same Side with the Planet, it is then *stationary to Retrogradation*; which *Retrogradation* will become visible in a few Days, and continue all the Time the Earth is on the same Side with the Planet. — And when the *Index* becomes a *Tangent* to the Earth's Orbit on the other Side, the Planet becomes *stationary to Direction*; which *Direction* of the Planet will take Place in a few Days, and continue all the Time the Earth is on the opposite Side the Sun.

(2.) For the Inferior Planets.

If the *Index* when laid from the *Earth* to either of the Inferior Planets, *Venus* or *Mercury*, does not cut their Orbit, but touch it only, then you are certain that the Planet is at its greatest *Elongation*, and *stationary* at that Time; and, if it lie on the right Hand the Sun, it is *stationary to Direction* — if on the left Hand, it is *stationary to Retrogradation*. But if the *Index* fall within the Orbit, the Planet is (if beyond the Sun) *direct* in Motion: But if on the same Side the Sun with the Earth, it is going *retrograde* in that Appearance.

✧ This Rule would hold exactly true, if the *Earth* were at rest in her Orbit: But as she advances at the same Time the same Way with the Planet, these *Stations* and *Retrogradations* will happen later on the left Hand, and sooner on the right Hand; the former arising from the Difference of their Motions; the latter from the Sum: For which Reason the following will be more exact. — Observe the Angle made at the Sun by the two Threads, and if it be

Deg.

66	} between the Earth and	{ Saturn	{ That Planet is <i>stationary to Retrogradation</i> , if on the left Hand Side the Earth; or <i>stationary to Direction</i> , if on the right Hand Side. —
53½			
22½			
15			
32			
		Jupiter	
		Mars	
		Venus	
		Mercury	If the Angle be less, the Planet is <i>retrograde</i> ; if bigger, it is <i>direct</i> in Motion.

XI. To

XI. To discover when any of the *primary Planets* shine in the Morning or Evening; that is, when they are *Morning* and *Evening Stars*.

Bring the Earth's Place in her Orbit so as to lie towards you; and lay the Index across the Instrument from the Earth through the Sun; then all those Planets on the *left Hand Side* of the Index are *occident*,* or *eastward* of the Sun --- shine in the *Evening*, and set after him. --- But all those Planets on the *right Hand Side* are *orient*,† or *westward* of the Sun, and shine in the *Morning* before the Sun rises.

☞ If a Planet be not farther from the Sun than 12 or 13 Degrees, either before or after him, it will not be visible in the Morning or Evening, by reason of the Sun's superior Light.

XII. To know when either of the *Inferior Planets*, *Venus* or *Mercury*, will *transit* the *Sun*, or appear as a Spot upon his Face.

If the Threads, when laid to the *Anomalies* of the *Earth* and *Venus* or *Mercury*, happen to coincide, or lie upon one another, then the inferior Planet must lie exactly between the *Earth* and the *Sun*; and if this happen at, or very near the Node of the Planet, it may be seen (with a common Telescope) to pass over the Sun's Face, making a black Spot upon his Disk. But if the Planet be not within a few Degrees of either Node, it will then pass under or over the *Sun*, just as it has *North* or *South Latitude* at that Time.

This being premised, we will proceed to illustrate all with an *Example* in each *Planet*.

* A Planet is said to be *Occident*, when it is more towards the East than the Sun; because it is then seen in the *occidental*, or western Part of the Horizon after the Sun is set.

† A Planet is said to be *Orient*, when it is nearer to the West than the Sun; because it appears then in the *oriental*, or eastern Part of the Sky in the Morning before the Sun rises.

To

To Calculate the Place of SATURN.

SATURN is the highest *Planet* in the System, having the Orbits of all the rest included within his Orb. The Time of his *Revolution* round the *Sun*, his *Distance*, *Aphelion*, *Perihelion*, *Nodes*, &c. are expressed in the preceding Table, and accurately projected on the Instrument.

This *Planet*, to us on the Earth, appears of a *dull Lead-colour*, and about the Size of *Aldebaran*, a Star of the first Magnitude. When viewed through a good *Telescope*, he appears to have a *Ring*, edge-ways, furrounding his Body, and five small *Satellites*, or *Moons* revolving round him beyond the Ring; all which apparently lie in the Space of two Hands-breadths off his Body.

The Times of the *Revolutions* of these *Satellites*, with their apparent Distances from *Saturn's* Body, as observed through a good *Telescope*, are as here set down.

		D.	H.	M.					
The First next him	} revolves about Saturn in	{	1	: 21	: 19	} at the Distance of	{	4 $\frac{1}{4}$	} Semi-diameters of Saturn's Body.
Second			2	: 17	: 40			6 $\frac{1}{4}$	
Third			4	: 12	: 25			12 $\frac{3}{4}$	
Fourth			15	: 22	: 41			20 $\frac{1}{2}$	
Fifth			79	: 7	: 48			59 $\frac{1}{4}$	

These *Moons* turn (like Ours) once round their *Axes* in every *Revolution*; and consequently keep the same Face always towards *Saturn's* Body.

The Diameter of his *Ring* is about 2 $\frac{1}{4}$ of *Saturn's* Diameter.

When *Saturn* is in the Middle of *Gemini* and *Sagittarius*, the *Ring* appears through the *Glass* quite open: But when in *Pisces* and *Virgo* the *Ring* seems shut; appearing as a right Line across his Body. The Plane of the *Ring* is nearly parallel to the Plane of our *Equator*.

Every Year and 13 Days he is conjoined to the *Sun*, and appears to move direct, to become stationary, and to run retrograde to us every Year. — His great Distance prevents our discovering his *Revolution* round his *Axis*; so that, that Phenomenon remains, at present, not perfectly defined.

His Place in the *Ecliptic*, at any Time, may be easily calculated in the following Manner*.

* The Calculations of the Places, Immersions, and Emersons of the *Satellites* of this Planet, with those of *Jupiter*, will be exhibited in a Work of itself.

EXAMPLE.

EXAMPLE.

Anno 1766, November 1st Day at Noon, I would know (by the Instrument) the *Heliocentric* and *Geocentric* Place of *Saturn* in *Longitude* and *Latitude*: His *Distance* from the *Sun* and from the *Earth*: And also, whether he is *direct*, *stationary*, or *retrograde*, at that Time.

OPERATION.

Write out the *Anomalies* of the *Earth* and *Saturn*, and equate them from the Tables thus :

Anomaly of \odot .				Anomaly of ♄ .						
	S.	D.	M.		S.	D.	M.			
1761	-	6	-	1	-	3	-	5	-	5
5	-	11	-	29	-	2	-	1	-	2
Nov.	-	9	-	29	-	0	-	10	-	10
1st Day	-	0	-	0	-	0	-	0	-	2
<hr/>				<hr/>						
Anomaly	-	4	-	1	-	5	-	16	-	19
subtract		0	-	1	-	0	-	1	-	42
<hr/>				<hr/>						
Anomaly	-	4	-	0	-	5	-	14	-	37

Having rectified the Instrument, by bringing the *Aphelion* Point of *Saturn's* Orbit opposite the Beginning of the outer Circle, letting it rest there;—lay one of the *Threads* on the *Earth's* *Anomaly* $4^{\circ} . 0^{\circ} . 12'$ on the upper Part, and it will cut her *true Place* in the *Ecliptic*; *i. e.* $89^{\circ}\frac{1}{4}$ — Next, lay another *Thread* to *Saturn's* *Anomaly* $5^{\circ} . 14^{\circ} . 37'$ on the lower Part, and it cuts the *Ecliptic* in his *Heliocentric Place* in $\pi 14^{\circ}\frac{1}{4}$. — The *Threads* remaining in this Position, lay the *graduated Edge* of the *Index* from *Saturn* to the *Earth*: Bring the *other Thread* parallel to it (by Help of a Pair of Dividers), and that *Thread* will cut the *Ecliptic* in almost 19° of π , which is his *Geocentric Place*, or Place, at that Time, seen from the *Earth*, as the other was seen from the *Sun**.

Saturn is now *retrograde*, not only because the *Index* cuts or falls considerably within the *Earth's* Orbit on this Side the *Sun*; but also, because the Angle made by the *Threads* at the *Sun* is less than 66° . — His *Distance* from the *Sun*, measured with the *Index* (or a Pair of Dividers), is about 739 Millions of Miles: His *Distance* from the *Earth*, about 670 Millions: His *Distance* from the nearest *Node* is $36^{\circ}\frac{1}{4}$, which gives, by the Tables at the End, for his *Heliocentric* Lat. or *Inclination* $1^{\circ} . 29'$. *South Ascending*; but his *Geocentric* Lat. is $1^{\circ} . 38'$. per Rule at Page 15th. — He shines in the Evening; and his *Ring*, which is now almost open, may be seen, and one or more of his *Satellites*, with a tolerable Telescope.

* As the Instrument now lies, there is formed a Triangle, in which is exhibited the Method of calculating by astronomical Tables; for there are given the Angle at the *Sun*, and (the Logarithms of) the two Sides, to find the Angle at the Planet; which, if the Angle at the *Sun* be less than 6 Signs, must be added to, but if more, subtracted from the *Heliocentric Place* to give the *Geocentric*. This holds in the Superior Planets, but in the Interior the Angle is applied just contrarywise, as the parallel Thread will shew you at all Times. For that Thread ever forms the same Angle at the *Sun*, as is made (by the *Index*) at the Planet; and falls either to the right or left Hand of the *Heliocentric Place*, as the Angle at the Planet by its Addition or Subtraction would make it.

To Calculate the Place of J U P I T E R.

NEXT within the Orbit of *Saturn* revolves the refulgent Planet *Jupiter*. He is a glorious Star of the *first Magnitude*, and greatly resembles *Sirius*, the great Dog-star, in Splendor, Colour, and Brightness.

Through an ordinary Telescope, he appears to shine with a *full-Face*, and to have several *Belts* on his Body; in the lower of which is a large *Spot*, by which his *Rotation* upon his *Axis* was discovered, and that his *Axis* is nearly perpendicular to his Orbit.—Round his *Equator*, or middle Parts, may be seen, with the same Glass, to revolve *four* small *Satellites*, or *Moons*, all which, when visible, lie nearly in a Right Line, and within a *Hand's Breadth* or *two* of his Body: But the Position of that Line has respect to the Situation of the *Ecliptic* at that Time.—The outermost *Satellite* passes wide of the Shadow of *Jupiter*, two Years in every six; but the other three pass through his Shadow in every Revolution, and are then *eclipsed*, and also *eclipse* one another.

Besides these *Immersion*s into his Shadow, they become twice invisible to us in each Revolution (except when the Latitude is too great); that is, once, when they are between the Eye and *Jupiter*; and again, when they are behind his Body.

Jupiter's Moons, or *Satellites*, revolve round his Body in the Times, and at the Distances here expressed.

		D.	H.	M.				
The First	} revolves round him in	1	18	36	} at the Distance of	5 $\frac{3}{4}$	} Semi-	diameters of Jupiter's Body.
Second		3	3	15		8 $\frac{1}{4}$		
Third		7	3	59		14 $\frac{1}{4}$		
Fourth		16	18	30		25		

When *Jupiter* is our *Morning Star*, and rises before the Sun, the Spectator sees only the *Immersion*s, or Entrance of the *Satellites* into *Jupiter's* Shadow. But when he is our *Evening Star*, and sets after the Sun, we then see the *Emersion*s out of his Shadow.

Every Year and 33 Days he is conjoined with the Sun, and then, for about 34 Days, lies hid under the Sun's Beams, and consequently becomes, at that Time, invisible to the naked Eye.

The other *Phænomena* of this Planet are exhibited in the former Table; and his Place at all Times may be easily found by the Instrument, as follows.

EXAMPLE

EXAMPLE.

Anno 1766, November 1st Day at Noon, let it be required to find the *Helio-*
centric and *Geocentric* Place of *Jupiter*, his *Latitude*, and *Distance* from the
Sun and from the *Earth*, and if he be *direct* in Motion, or *stationary*, or *retrograde*.

OPERATION.

From the Tables collect the *Anomalies* of the *Earth* and *Jupiter*, with their
Equations, as under.

Anomaly of \odot .				Anomaly of \sphericalangle .						
	S.	D.	M.		S.	D.	M.			
1761	-	6	-	1	-	4	-	27	-	20
5	-	11	-	29	-	5	-	1	-	42
Nov.	-	9	-	29	-	0	-	25	-	16
1st Day.	-	0	-	0	-	0	-	0	-	5
<hr/>				<hr/>						
Mean Anomaly	-	4	-	1	-	10	-	24	-	23
Equation subtract		0	-	1	-	0	-	3	-	3
<hr/>				<hr/>						
True Anomaly	-	4	-	0	-	10	-	27	-	26
<hr/>				<hr/>						

Having brought the *Aphelion* of *Jupiter* to the Beginning of the outer Circle, lay a Thread to his Anomaly, $10^{\circ} 27' 26''$. on that Circle, and it will cut the *Ecliptic* in $\approx 8^{\circ} \frac{1}{4}$, which is his *Heliocentric* Place.—Another Thread brought to the *Earth's* Anomaly $4^{\circ} 0' 12''$. on the upper Circle, cuts her *Heliocentric* Place (as before) in $\approx 8 9^{\circ} \frac{1}{4} *$. — Then the *Index* being laid from *Jupiter* in his Orb to the *Earth* in her's, and the other Thread brought parallel to it, that Thread will cut the Planet's *Geocentric* Place in almost $\approx 16^{\circ} \frac{1}{4}$.

Jupiter is now *direct* in Motion, because the Index falls within the *Earth's* Orbit, and he is *beyond* the Sun; and the Angle made at the Sun by the two Threads is more than $52^{\circ} \frac{1}{2}$. — He is now advancing towards his *Aphelion*, and shines gloriously in the *Morning*. — His Distance from the nearest *Node* is $59^{\circ} \frac{1}{4}$; which gives for his *Heliocentric* Lat. $1^{\circ} 9'$.—His Distance from the *Sun* is about 440 Millions of Miles; and from the *Earth*, about 489 Millions; which makes his *Geocentric* Lat. $1^{\circ} 2'$, *North Ascending*.

Jupiter being now a *Morning Star*, may be seen, and all his *Satellites*, with a tolerable Glafs, and their *Immersion*s into his Shadow (should it so happen at that Time) as they pass behind him.

* The Place of the *Sun* is always exactly opposite to the Place of the *Earth* (which the Reader will observe once for all). Consequently, the *Heliocentric* Place of the *Earth*, and the *Geocentric* Place of the *Sun*, must be continually in *Signs* and *Degrees* of the *Ecliptic* directly opposite to one another. For this Reason it is, that Astronomers speak of the *Motion* of the *Sun*; and in their Computations, from their Tables, use the Quantities of his *apparent* Motion, as if it was *real*.

THE HEAVENS SURVEYED.

To Calculate the Place of MARS.

MARS moves round the *Sun* in an Orb between the *Earth* and *Jupiter*. He appears of a *fiery red Colour*, and to the naked Eye of different Sizes; sometimes as large as a Star of the *first* Magnitude; at other Times not scarcely so large as one of the *second*.

Through the Telescope he appears to increase and decrease in Light like the *Moon*; and when three Signs distant, is nearly bisected, or divided in *two*.

This Planet is five Times nearer us at one Time than another; consequently, his Appearance, with respect to his Size, must be so much larger in the former Situation than the latter.—He makes all the Aspects with the *Sun*, and in Opposition to that Luminary is almost as near the *Earth* as *Venus*: Much nearer than *Mercury* or any of the other *Planets* *.—Between each Conjunction with the *Sun* he spends about two Years and 50 Days—and becomes *direct*, *stationary*, and *retrograde* to us, as all the other Planets do.

He does not appear to have any *Satellites*, or *Moons*, surrounding him, tho' it is very probable he has one or more,—A broad clouded *Belt* has been observed to shadow nearly half his Disk; and several *Spots* have been seen upon his Body, by which his Revolution on his Axis was discovered.

His *Distance* from the *Sun*, *Period*, *Aphelion*, *Node*, &c. &c. are inserted in the foregoing Table, and therefore it becomes needless to repeat them here.—His Place in the Heavens, at any Time, is easily found from the Instrument thus.

* As *Mars*, when in Opposition to the *Sun*, appears about five Times larger in Diameter than when he is in Conjunction with him; he must be therefore five Times nearer us in one Position than the other: For the apparent Magnitudes of distant Objects *increase* or *decrease* in Proportion to their Distances from us; but this Planet *Mars* keeps always, nearly, the same Distance from the *Sun*; it is therefore plain, even to Demonstration, that it is not the *Earth*, but the *Sun*, that is the Center of his Orbit, and of the System.

EXAMPLE.

E X A M P L E.

Anno 1766, November 1st Day at Noon, what is the Place of *Mars* in *Longitude* and *Latitude*; his *Distance* from the *Sun* and *Earth*; and his other *Aspects* at that Time, as seen from hence.

O P E R A T I O N.

Collect the *Anomalies* of the *Earth* and *Mars*, with their *Equations*, and set them down thus.

Anomaly of Θ .					Anomaly of δ .				
	S.	D.	M.			S.	D.	M.	
1761	-	6	-	1 - 34	1761	-	5	-	25 - 57
5	-	11	-	29 - 42	5	-	7	-	26 - 51
Nov.	-	9	-	29 - 37	Nov:	-	5	-	9 - 18
1st Day	-	0	-	0 - 59	1st Day	-	0	-	0 - 31
<hr/>					<hr/>				
Mean Anomaly	-	4	-	1 - 52	Mean Anomaly	-	7	-	2 - 37
Equation subtract	-	0	-	1 - 40	Equation add	-	0	-	6 - 20
<hr/>					<hr/>				
True Anomaly	-	4	-	0 - 12	True Anomaly	-	7	-	8 - 57
<hr/>					<hr/>				

Bring the *Aphelion* of *Mars* to the Beginning of the *outer Circle*, and lay a Thread to his *Anomaly*, as expressed in the Operation above, and it falls in the *Ecliptic* upon his *Longitude* or *Heliocentric Place*, in almost 811° . A Thread laid also upon the *Earth's Anomaly*, gives for her *Heliocentric Place* $89^{\circ}\frac{1}{4}$. —Next, lay the *Index* from *Mars* to the *Earth*, and bring the other Thread parallel thereto; it then cuts his *Geocentric Place* in $29\frac{1}{2}^{\circ}$, and *there* he appears as beheld from the *Earth*.

The *Distance* of *Mars* from the nearest *Node* is 37° . and his *Heliocentric Latitude* $1^{\circ}.7'$. His *Distance* from the *Sun* 114 Millions of Miles, and from the *Earth* 57 Millions; consequently his *Geocentric Lat.* is $2^{\circ}.14'$. *South Descending*.

This *Planet* is now an *Evening Star*, and *direct* in Motion: And, as he has lately passed his *Perihelion*, and is on the same Side in *Perigeon*, or near the *Earth*, he must appear large and brilliant, like a *Star* of the *first Magnitude*. But as the *Earth* advances further in her Orb, *Mars* will apparently grow less; and when they are come on opposite Sides the *Sun*, his Diameter will be almost five Times less; consequently, his Light will be diminished to one twenty-fifth Part of what it is at this Time.

OBSERVATIONS ON THE SYSTEM From the EARTH.

HAVING in the foregoing Part of this Treatise given the Reader a View of the System from the *Sun*, the Center of it; we will now review it with him from the *Earth*, the Planet on which he, at present, resides: By this means he will be enabled to account for the various and seemingly irregular Appearances of the *Planets*; as why they sometimes seem *bigger*, and sometimes *less*; why they sometimes move forwards, and backwards, and sometimes seem not to move at all.—In Order to this it will be necessary to delineate the several Planetary Orbs, with the *Planets* upon them; and then, by transferring the Eye from the *Earth* to those Bodies, he will instantly perceive all the *Phænomena* just as in the System itself*.

From the same Scheme it is evident, that to an Eye at the *Earth* the Planets *Mercury* and *Venus*, when on *this Side* the *Sun*, must pass between us and him; and with a Telescope may sometimes be seen to make a black Spot upon his Face. But when on the *other Side*, they pass behind him; and in that Position he may sometimes intervene and eclipse them†.

The *dotted Lines* drawn from the *Earth*, touching the Orbs of *Mercury* and *Venus* on the Right Hand and on the Left, evidently show that these Points are the greatest Distance which those Planets can ever be seen from the *Sun*. The Distance of *Mercury* is never more than 28 Degrees; nor of *Venus* more than 48. These Distances are called their *greatest Elongations* on either Side.

Apparent also it is from the Projection, that all the time those two Planets pass from their greatest Elongations on the Right Hand, or Western Side, round the *Sun*, to their greatest Elongations on the Left Hand, or Eastern Side, they must seem to move through the Heavens according to the Order of the Signs; *i. e.* from γ to δ , from δ to π , &c. But from their greatest Elongation on the Left Hand, they appear to move the contrary Way, *i. e.* from π to δ , from δ to γ , &c.—During this State they are said to be *retrograde*.

When these Planets lie exactly between the *Earth* and the *Sun* they are said to be in their *inferior Conjunctions*; and appear wholly dark, because their upper Sides

* The *Moon*, which is our Earth's *Satellite*, revolves round the Earth in $27^d. 7^h. 43'$. Her various *Phænomena*, with the *Moons* of *Saturn* and *Jupiter*, will be considered in a future Work.

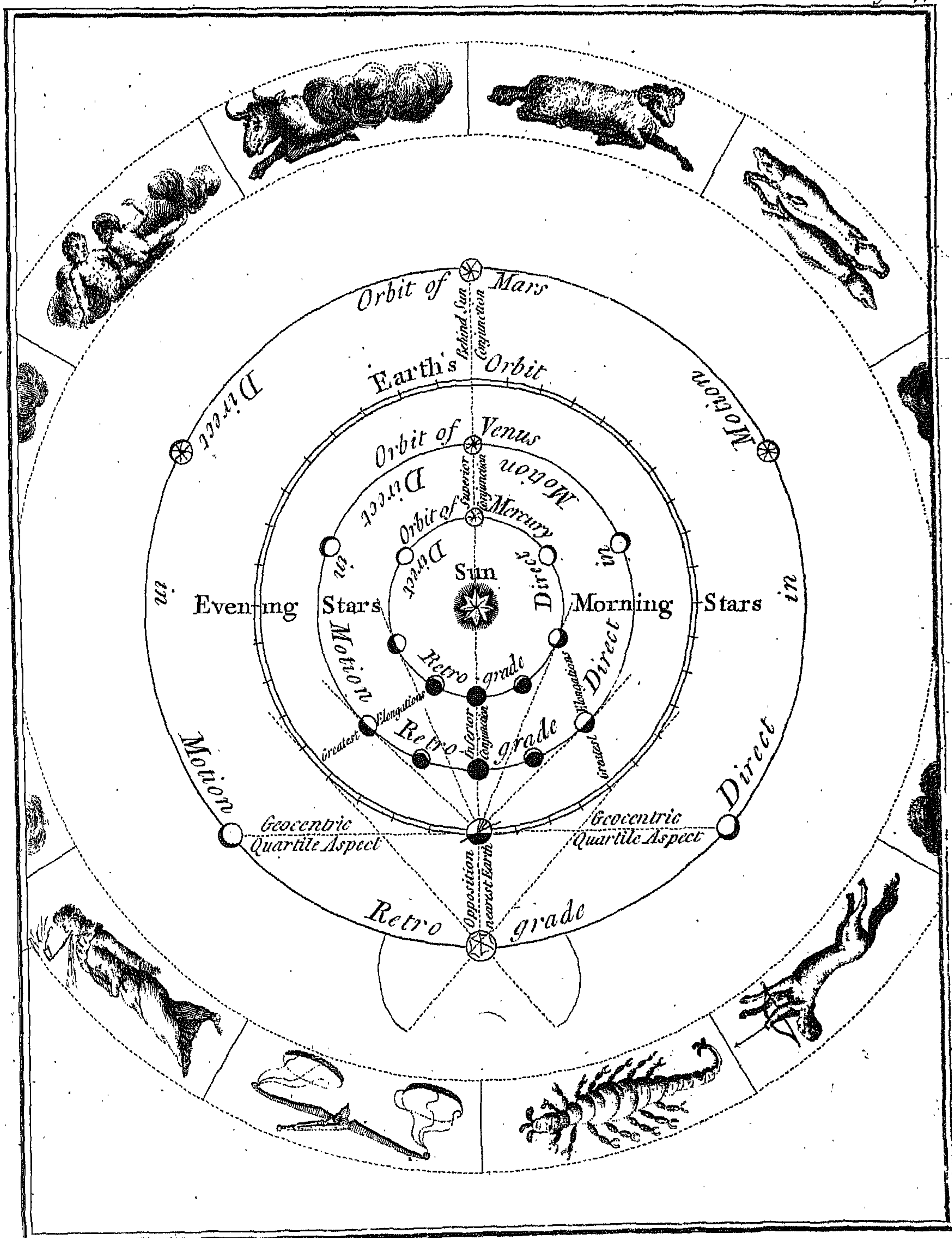
† From an Inspection of this Scheme it is plain, that as a Spectator at the *Sun* would see the *Earth* (or any other Planet) revolve thro' the Signs of the *Ecliptic*; so to a Spectator on the *Earth* (or Planet) the *Sun* will apparently revolve the same Way, but always in the opposite Point. For it is well known, that a fixed Object (as the *Sun* is) appears to change its Place by the Motion of the Observer round it.

A V I E W O F T H E SYSTEM from the EARTH,

The Place of our present RESIDENCE ;

In which is clearly seen the true Reason of the *Directions*, *Stations*, *Retrogradations*, and *Elongations* of the Planets, and the different *Phases* they exhibit to us (in the different Parts of their Orbits) thro' the Telescope.

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only are illuminated by the *Sun*. But as they recede from that Position, they turn some Part of their enlightened Surface towards us, and appear through the Telescope like a *New Moon* of three or four Days old. This Light will continue to increase as they pass round the Sun to their *superior Conjunctions*, where they turn their whole enlightened Hemisphere towards us. From thence they begin to *decrease* in their Light, appearing first *gibbous*, then *bisected*, and lastly *horned*, as delineated in the Scheme.

Though *Venus* and *Mercury* (but particularly *Venus*) a little before their *Elongations* on the Right Hand, and a little after their *Elongations* on the Left Hand, turn but a small Portion of their enlightened Surface towards us; yet they will appear more *large*, *brilliant*, and *glorious*, than in any other Parts of their Orbits; because that small Part will apparently contain, at those Places, a greater Area of Light, than the whole Disk when they are at their greatest Distances, *four* or *five* Times farther off, *beyond* the *Sun*.

These are the principal *Phænomena* of the *inferior* Planets *Mercury* and *Venus*: Let us proceed to view the *superior*, *Mars*, *Jupiter*, and *Saturn*. But as the *Phænomena* of one of them, *viz.* of *Mars*, will fully elucidate and explain the Appearances of them all, I shall, to prevent the Projection from swelling too wide, consider the Revolution and Appearances of that Planet only.

When a *superior* Planet, as *Mars*, is in that Part of his Orbit nearest the Earth, on the same Side with her, he is said to be in *Opposition* to the Sun; at which Time all the illuminated Surface of that Planet is turned towards the Earth, and he appears, through the Glass, *round* like a *Full Moon*. But as he proceeds towards his *Quartile Aspect* he decreases in his Light, and appears there *gibbous*, or a little like a Moon a few Days before the *full*. As he goes on from thence, he recovers his Light, and shines with a full Face, till he arrives at his *Conjunction* with the *Sun*, where he becomes invisible, on Account of the Sun's superior Light. As he comes round from the Sun to his *Quartile Aspect*, he appears *gibbous* again, but on the contrary Side; and then recovering his Light as he advances, shines with a full Orb to his *Opposition*.

☞ This Appearance cannot take Place in *Saturn* and *Jupiter*, on Account of their vast Distances, but is very conspicuous in this Planet.

The *dotted* Lines from *Mars* to the Earth's Orb, shew the Places where the Earth appears at that Planet to be her *greatest Elongation*, which never exceeds 34 Degrees.—The *Earth*, to an Eye at *Mars* will seem to pass *retrograde* thro' the *inferior* Part of her Orb; but *direct* in Motion through the *superior* Part; and will appear *horn'd*, *bisected*, *gibbous*, and *full*, through the Glass, just as *Venus* does to us here. *Mars* will appear enlightened in like Manner (if visible there) to the Inhabitants of *Jupiter*; and *Jupiter* to those of *Saturn*.

☞ These Appearances, which utterly confound and overthrow the *Ptolemaic* Hypothesis, are conclusive Proofs of this *Copernican System*, and cannot fail of establishing it upon a Foundation which shall be as lasting as that of the *System* itself.

To Calculate the Place of VENUS.

NEXT within the Orbit of the Earth revolves the Planet *Venus*. She is the most splendid and glittering of all the *Planets*; and so large as to be seen even in the Day Time. — As the Orbit of this Planet is contained within the Orbit of our Earth, she can never come in Opposition to the Sun, (as the superior Planets *Mars*, *Jupiter*, and *Saturn* do) but always continues near him; being never more than 47 Degrees on either Side from him; which Distance is called her *greatest Elongation*.

When she is *orient*, *i. e.* on the *Western Side* the Sun, she comes to a *Conjunction* with him by *direct* Motion in the upper Part of her Orbit; and is then in *Apogee*, or most distant from us: But when she is *occident*, *i. e.* on the *Eastern Side* the Sun, she comes round to a *Conjunction* with the Sun by a *retrograde* Motion, and is then in *Perigee*, and about six Times nearer the Earth than in the former Situation; that is, nearer by the whole Diameter of her Orbit, as is plain by an Inspection of the Instrument.

Through the *Telescope* she appears to *increase* and *decrease* like the Moon; and is sometime *horned* and sometimes *gibbous*; which is a manifest Proof that her Orbit is wholly included within ours.

This Planet, when in *Conjunction* with the Sun in the upper Part of her Orbit, and near her Node, will pass behind the *Sun's* Body, and be eclipsed:—But when she is in *Conjunction* with the Sun in the lower Part of her Orbit, *i. e.* in the Part next us, and very near her Node, she may be seen, with the *Telescope*, to pass over the *Sun's* Face; making a *black Patch* upon him, like a *Beauty-spot* in a Lady's Face.

Venus can never be seen at *Midnight*; but only in the *Morning* and *Evening*, just as she happens to be *Westward* or *Eastward* of the Sun. When she appears in the Morning, she is called the *Morning-star*; and when in the Evening, she is called the *Evening-star**. — To us here, she appears to be stationary and retrograde once every two Years. Her *Period*, *Distance*, *Aphelion*, and *Nodes*, and other Affections, are exhibited in the foregoing Table, and her Place in the Heavens is easily obtained in the following Manner.

* This Planet appears brightest and largest at about 40 Degrees from her inferior Conjunction, before and after it.

EXAMPLE.

EXAMPLE.

Anno 1766, November 1st Day at Noon, the Place of *Venus* is required both *Heliocentric* and *Geocentric*; also her Distance from the *Sun* and *Earth*; and whether she be *direct*, *stationary*, or *retrograde* at that Time.

OPERATION.

Write down the *Anomalies* and *Equations* of the *Earth* and *Venus* from the Tables, as follow.

Anomaly of Θ .				Anomaly of φ .				
	S.	D.	M.		S.	D.	M.	
1761	-	6	-	1	-	26	-	22
5	-	11	-	29	-	15	-	29
Nov.	-	9	-	29	-	7	-	3
1st Day	-	0	-	0	-	1	-	36
<hr/>				<hr/>				
Mean Anomaly	-	4	-	1	-	20	-	30
Equation subtract		0	-	1	-	0	-	37
<hr/>				<hr/>				
True Anomaly	-	4	-	0	-	21	-	7
<hr/>				<hr/>				

The Instrument being rectified, by bringing the *Aphelion* of *Venus* to the Beginning of the lower Circle; and the Threads laid to their respective *Anomalies*, will give in the *Ecliptic* for the *Longitude*, or *Heliocentric Place* of *Venus* $28\frac{1}{2}^{\circ}$, and for the *Earth*, $89\frac{1}{4}^{\circ}$.—The Index laid from *Venus* to the *Earth*, and the other Thread placed parallel to it, gives *Venus's Geocentric Place*, $22\frac{1}{4}$.

At this Time *Venus* is distant from the nearest *Node* about 76° . which gives by the Tables, her *Inclination*, or *Heliocentric Latitude*, $3^{\circ}. 7'$. Her Distance from the *Sun* is nearly 59 Millions of Miles, and from the *Earth* 130 Millions; therefore her *Latitude* from hence must be $1^{\circ}. 29'$. *North Descending*.

Venus is now *direct* in Motion, advancing towards her *superior Conjunction*, and will be seen in the *Morning* before the *Sun*; at which Time, if viewed with a good Glafs, she will appear *gibbous*, or like a *Moon* a few Days before the Full.—She may also be seen in the Day-time by the same Glafs, if it be directed properly to her Place in the Heavens. But the best Time to view this Planet by Day is, when she is a few Degrees *before* or *after* her *inferior Conjunction*; for then she appears *horned*, like a *New Moon*, with the illuminated Part turned towards the *Sun*.

To Calculate the Place of MERCURY.

WITHIN the Orbit of *Venus*, and next the *Sun*, revolves the Planet *Mercury*. He is the nearest to the *Fountain of Light* of all the *primary Planets*. He is but seldom seen, because his Orb lies so near the *Sun*; for at his greatest Distance on either Side him, he is never found further than 27 or 28 Degrees.

This *Planet*, as well as *Venus*, can never come into *Opposition* with the *Sun*; nor be seen — only in the Evening just after Sun-set, or in the Morning just before he rises.

Mercury becomes *direct*, *stationary*, and *retrograde* three or four Times every Year to us at the Earth; but, like *Venus*, makes no Aspect with the *Sun* but his *Conjunction*.——When he is conjoined with the *Sun* in the upper Part of his Orb, he is always *direct* in Motion; and, if near his Node, will pass behind the *Sun's Body*: But when conjoin'd with the *Sun* in the lower Part of his Orb, he is ever *retrograde*; and, if near his Node, he may be seen, with a good Telescope to make a small black Patch on the *Sun's Disk*.

At his *inferior Conjunction*, *Mercury* is nearer the Earth than at his *superior Conjunction* by the Diameter of his Orbit.——He appears the *smallest* of all the primary Planets; — is of a sparkling red Colour, greatly resembling the Planet *Mars*, but not quite so large. — His lying so near the *Sun*, makes it impossible for us to make the same Observations on him with the Telescope as on the rest of the Planets: For we have not been able (on Account of the Heavens being so strongly illuminated by the *Sun* when he is visible) to discover from hence any Spots on his Body, or if he revolve on his Axis or not.

The Time of his *Revolution* round the *Sun*, *Distance*, Places of his *Nodes*, *Aphelion*, &c. are before expressed in the general Table: and his Place, at any Time, is easily calculated as follows.

EXAMPLE

EXAMPLE.

Anno 1766, November 1st Day at Noon, suppose it be required to find by the Instrument the Place of *Mercury* in *Longitude* and *Latitude*, as seen from the *Sun* and from the *Earth*; also his *Distance* from those Places; and whether he be *direct*, *stationary*, or *retrograde*, &c.

OPERATION.

From the Tables collect the *Anomalies* of the *Earth* and *Mercury*, and their *Equations*, as here set down.

Anomaly of ☉.				Anomaly of ☿.			
	S.	D.	M.		S.	D.	M.
1761	- 6	- 1	- 34	1761	- 8	- 2	- 43
5	- 11	- 29	- 42	5	- 9	- 2	- 36
Nov.	- 9	- 29	- 37	Nov.	- 5	- 14	- 4
1st Day	- 0	- 0	- 59	1st Day	- 0	- 4	- 6
Mean Anomaly	- 4	- 1	- 52	Mean Anomaly	- 10	- 23	- 29
Equation subtract	- 0	- 1	- 40	Equation add	- 0	- 11	- 32
True Anomaly	- 4	- 0	- 12	True Anomaly	- 11	- 5	- 1

Bring the *Aphelion* of *Mercury* (as you did the rest of the Planets) to the Beginning of the *outer Circle*; lay the Threads to their *Anomalies* severally, and they will cut the *Ecliptic* in $89\frac{1}{4}^{\circ}$. for the Place of the *Earth*, and $m\ 18^{\circ}$. for the Place of *Mercury*, as seen from the *Sun*.—Lay the Index from the *Earth* to *Mercury* (which is almost a Right-line); bring the other Thread parallel to it, and it will fall upon $m\ 12\frac{1}{4}^{\circ}$. his true Place seen from the *Earth*.

Mercury is now about 3 Degrees from the *Node*. His Inclination, or *Latitude* at the *Sun*, is $22'$. His *Distance* from the *Sun* is 36 Millions of Miles, and from the *Earth* 116 Millions; which gives his *Latitude*, as seen from the *Earth*, about $7'$. *South Descending*.

He is now in the upper Part of his Orbit; is in *Apogee*; has just past his *superior Conjunction*, and is *direct* in Motion; but lies so near the *Sun* as not to be *visible*, rising and setting nearly at the same Time with him.

✧ If two white *Beads*, having that Half blacked opposite the *Sun*, be brought, one of them to the *Earth's Place*, the other to the Planet's in their Orbs, you may pleasantly see how much of that Planet appears to be illuminated at the *Earth*, and also what Aspect the *Earth* appears in at that Planet.

To

To Calculate a TRANSIT of VENUS over the SUN's DISK.

AS the Orbit of *Venus* is wholly included in the Earth's Orbit, she must sometimes interpose between us and the *Sun*; and if that Interposition should happen at either of her *Nodes*, (that is, just at the Intersection of her Orbit with the Plane of the Earth's Orbit) she must apparently pass over the Sun's Face.—The Places where these two Intersections are made are at 14 Deg. 34 Min. of *Gemini*, and 14 Deg. 34 Min. of *Sagittarius*.—The former is the Place of her *Ascending Node*; *i. e.* where she ascends above the Plane of the the Earth's Orbit;—The other is her *Descending Node*, or Place where she descends below it. *Transits* of this Planet can therefore only happen in those Months in which the Earth is in these two Signs, and near the Degrees where the *Nodes* are situate; that is, in the Beginning of *June* and *December*: At all other Seasons of the Year, that Planet will pass under or over the Sun's Disk, without producing that agreeable *Phænomenon*.

Now it has been found by *Astronomical Calculation*, that *Venus* will return to the same Situation with the *Earth* every 8 Years, 235 Years, and 243 Years nearly: *Transits* will therefore happen at the End of these Intervals; but more exactly as expressed in the following Tables.

A TABLE of the Periods of VENUS's Retrograde Conjunction with the *Sun* at the *Ascending Node* in the Month of *December*.

	Years.	D.	H.	M.		Latitude of Venus.
	8—subt.	2	: 10	: 52½	- - -	24' : 41" South.
Add	235—add	2	: 10	: 9	- - -	11 : 33 North.
	243—subt.	0	: 0	: 43	if Common Year } 13 : 8 South.	
	243—add	0	: 23	: 17		
					if Leap Year	

Angle of the visible Way of <i>Venus</i> over the Sun's Disk	-	9° : 5' : 0"
Semidiameter of the <i>Sun</i> at that Time	- - -	0 : 16 : 21
The Hourly Motion of <i>Venus</i> within the Sun	-	0 : 4 : 7
Consequently, the greatest Duration of the <i>Transit</i> is	-	7 ^h : 56' : 0"

Venus was within the *Sun's Disk* at this Node, *New Style*,
1639, *December* 5 D. 6 H. 37 M. with 8 M. 30 Sec. *South Latitude*.

A TABLE of the Periods of VENUS's Retrograde Conjunction with the *Sun* at the *Descending Node* in the Month of *June*.

	Years.	D.	H.	M.		Latitude of Venus.
	8—subt.	2	: 6	: 58	- - -	19' : 58" North.
Add	235—add	2	: 8	: 18	- - -	9 : 21 South.
	243—add	0	: 1	: 23	- - -	10 : 37 North.

☞ In Leap Year subtract or add one Day more.

Angle of the visible Way of <i>Venus</i> over the Sun's Disk	-	8° : 28' : 0"
Semidiameter of the <i>Sun</i> at that Time	- - -	0 : 15 : 50
The Hourly Motion of <i>Venus</i>	- - -	0 : 4 : 0
And, the greatest Duration of the <i>Transit</i> is	-	7 ^h : 56' : 0"

Venus was seen within the *Disk* of the *Sun* at this Node,
1761, *June* 5 D. 17 H. 55 M. with 4 M. 15 Sec. *South Latitude*.

* For the Rationale of these Numbers, see Dr. *Halley's* Discourse in the *Philosophical Transactions*, No. 193,—or *Whiston's Lectures*.

From the Periods of *Venus* here laid down, it will be very easy to compute the Time of any future *Transit*, by Addition and Subtraction only. For if to the Time of any *Transit* given, you add or subtract the first Period, and increase or decrease the *Latitude*, as much as the Table directs at that Period, you will have the Return of the next Conjunction of *Venus* with the *Sun* at that *Node*, with her *Latitude* at that Time; which if less than the *Sun's* Semidiameter, there will happen another *Transit*.

If the first Period does not bring the *Latitude* within the Limits prescribed, you must try with the second Period; and if that does not do, apply the third Period: Always remembering to use the first before the second, and the second before the third; as in the following Example:

EXAMPLE I.

I would know the Time of the next *Transit* of *Venus* over the *Sun* at the *Ascending Node* in the Month of *December*.

OPERATION.

	Year.	D.	H.	M.	M. Sec.
Venus in the ☉ at Ascending 8	1639	Dec. 5	:	6 : 37	Lat. 8 : 30 South.
First Period - add	8	subt. 2	:	10 : 52*	24 : 41 South.
	1647	Dec. 2	:	19 : 45	33 : 13 South.

Hence it appears that *Venus* will pass below the *Sun's Disk*, because her *Latitude* exceeds the *Sun's* Semidiameter, 16'. 21". by many Minutes. We must therefore try the second Period.

	Year.	D.	H.	M.	M. Sec.
Venus in the ☉ at Ascending 8	1639	Dec. 5	:	6 : 37	Lat. 8 : 30 South.
Second Period - add	235	add 2	:	10 : 9	† 11 : 33 North.
	1874	Dec. 7	:	16 : 46	3 : 3 North.

At this Time *Venus* will be seen in the *Sun*, and will pass over his Disk, about 3 Minutes northward of his Center.

EXAMPLE II.

I would also know when the next *Transit* of *Venus* will happen at the *Descending Node* in the Month of *June*.

OPERATION.

	Year.	D.	H.	M.	M. Sec.
Venus in the ☉ at Descending 8	1761	June 5	:	17 : 55	Lat. 4 : 15 South.
First Period - add	8	subt. 2	:	6 : 58	19 : 58 North
	1769	June 3	:	10 : 57	15 : 43 North.

These are all the *Transits* of *Venus* that will happen in *this* and the next Century.

* In this Example you add the Years, but subtract the Days, Hours, and Minutes.

† Here you must subtract the less *Latitude* from the greater, because they are different: But when alike (*i. e.* both *North*, or both *South*), add them together.

To Calculate a TRANSIT of MERCURY over the SUN's DISK.

THE Orbit of *Mercury* (as well as that of *Venus*) lying within the Orbit of the Earth, there must necessarily happen the like Appearances in this Planet as in that; but they are more frequent in *Mercury* than in *Venus*, because of his quicker Circulation, and speedier Arrival to the same Places with the Earth. The *Nodes* of this Planet, *i. e.* the Places where his Orbit cuts the Plane of the Earth's Orb are in $15^{\circ}.45'$ of *Taurus*, where he ascends above the *Ecliptic*; and in $15^{\circ}.45'$ of *Scorpio*, where he descends below it. All *Transits* of *Mercury* must happen in the Beginning of *May* and *November*, when the Earth is in those Signs where his Nodes are.

The several Periods of *Mercury's* Conjunction with the Sun, both at the *Ascending* and *Descending Node* (as determined by Astronomical Observations and Calculations), are exhibited in the following *Tables*.

A TABLE of the Periods of MERCURY's Retrograde Conjunction with the *Sun* at the *Ascending Node* in the Month of *November*.

Years.	D.	H.	M.	Latitude.
Add	6—add	8	17 : 25	} $30' : 50''$ North.
	6—add	9	17 : 25	
	7—subt.	7	0 add 9	} $22' : 47''$ South.
	7—subt.	6	0 add 9	
	13—add	2	17 : 34	} $8' : 3''$ North.
	13—add	1	17 : 34	

The Angle of *Mercury's* visible Way over the Sun - $8^{\circ} : 15' : 0''$

The *Sun's* apparent *Semidiameter* at that Time - $0 : 16 : 5$

Mercury was in the *Sun* at this Node, *New Style*,
1756, Nov. 6 D. 16 H. 36 M. with 0 M. 39 Sec. *South Latitude*.

A TABLE of the Periods of MERCURY's Retrograde Conjunction with the *Sun* at the *Descending Node* in the Month of *May*.

Years.	D.	H.	M.	Latitude.
Add	13—add	3	7 : 37	$16' : 55''$ South.
	20—subt.	4	8 : 0	$30 : 57$ North.
	33—subt.	1	0 : 23	$14 : 2$ North.
	46—add	7	14 : 0	$2 : 53$ South.
	79—subt.	0	17 : 9	$8 : 16$ North.
	265—add	0	11 : 49	$22 : 0$ South.

☞ If it be Leap Year, add or subtract one Day more.

The Angle of the visible Way of *Mercury* over the *Sun* - $10^{\circ} : 18' : 0''$

The apparent *Semidiameter* of the *Sun* - $0 : 15 : 46$

Mercury was in the *Sun* at this Node, *New Style*,
1753, May 5 D. 19 H. 20 M. with 1 M. 19 Sec. *South Latitude*.

In the same Manner as you calculated the Times of the future *Transits* of *Venus*, you may calculate, by these Tables, those of *Mercury*: An Example or two will make all plain.

E X A M P L E I.

Suppose you would know the next *Transit* of *Mercury* over the *Sun* at the *Ascending Node* in the Month of *November*.

As *Mercury* (at the Time of the last *Transit*) had such *small Latitude*, I perceive immediately, from the Table, that the *Latitude* of *Mercury* at the two first Periods is too *great* to produce that Phænomenon: For at the End of the first Period of six Years he will go *North*, and in the second of seven Years *South* of the *Sun's Disk*: I therefore make use of the third Period thus.

	Years.	D.	H.	M.	M. Sec.
Mercury was in the ☉	1756 Nov.	6	:	16 : 36	with Lat. 0 : 39 S.
The third Period -	13	add	2	:	17 : 34
					8 : 3 N.
Next Transit at Ascending ☿	1769 Nov.	9	:	10 : 10	7 : 24 N.

E X A M P L E II.

When will *Mercury* transit the *Sun* next, at the *Descending Node* in the Month of *May*?

In this Example, the *Latitude* of *Mercury* carrying him above or below the *Disk* in the two first Periods, I apply the third, as under.

	Years.	D.	H.	M.	M. Sec.
Mercury in the ☉ at Descending ☿	1753 May	5	:	19 : 20	with Lat. 1 : 19 S.
3d Period, because Leap Year, add 33 subtr		2	:	0 : 23	14 : 2 N.
Next Transit at Descending ☿	1786 May	3	:	18 : 57	12 : 43 N.

In this Example I subtracted one Day more on Account of its being Leap Year.

☞ When the *Latitudes* are both of one Name, *add* them together; but when of different Names *subtract* the smaller from the larger, and the Remainder will be *Latitude* at that Time.

The other *Transits* of *Mercury* which fall within this Century, are,

Years.	D.	H.	M.	M. Sec.
1776 Nov.	2	:	10	19
1782 Nov.	11	:	3	44
1786 May	3	:	18	57
1789 Nov.	5	:	3	53
1799 May	7	:	2	34

} with {

15 : 23	South Latitude.
15 : 27	North Latitude.
12 : 43	North Latitude.
7 : 20	South Latitude.
4 : 12	South Latitude.

☞ If to any of these Periods of *Venus* or *Mercury* you find the Planet's *Anomaly* with the *Earth's*, and lay the Threads thereto, you will find them lie upon each other; which proves them to be, at that Time, in *Conjunction*, if viewed from the *Sun*: Consequently, the Planet seen from the *Earth* (as it is then near the *Node*) will appear in the *Sun's Disk*.

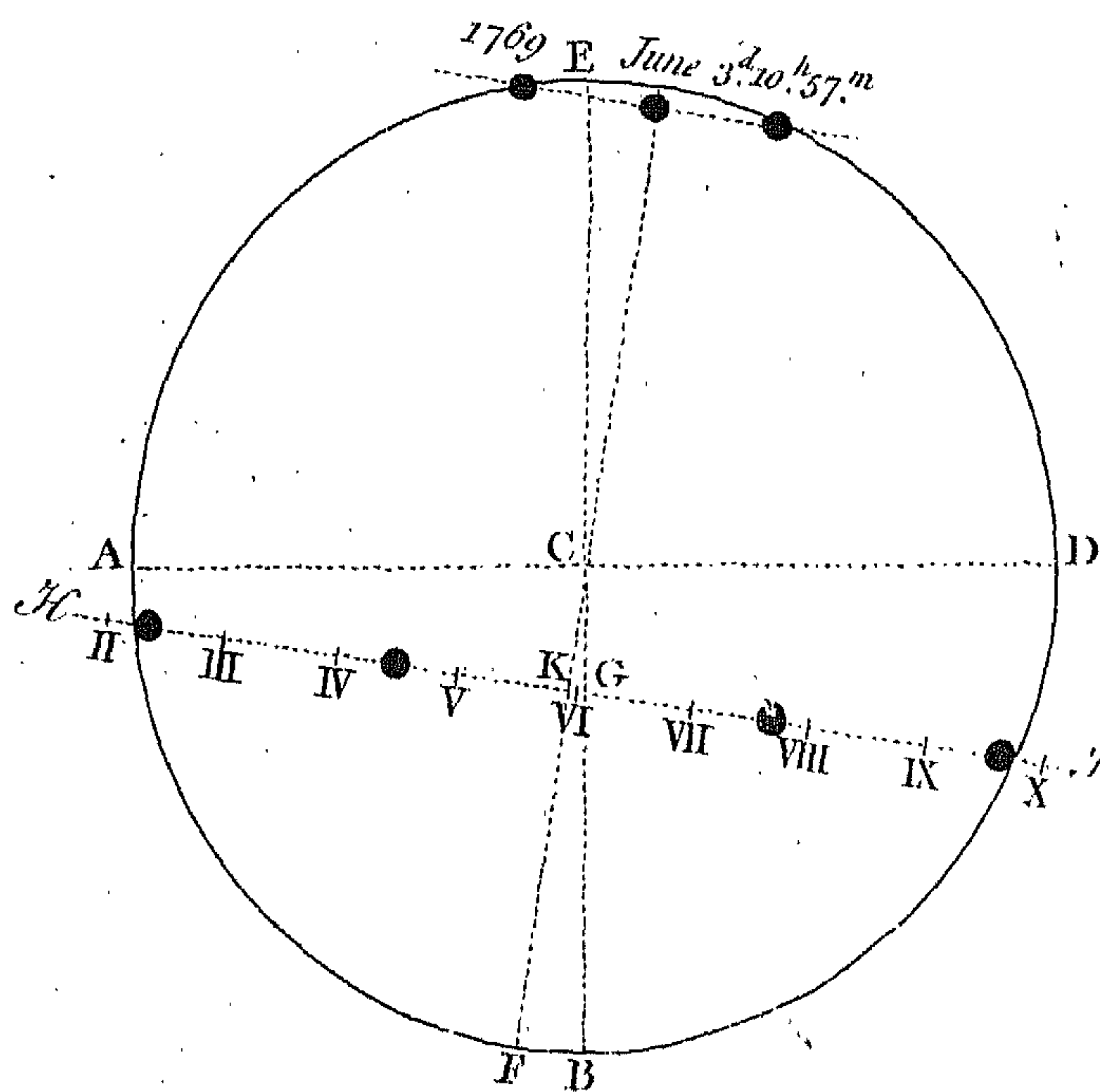
To

To Delineate a TRANSIT of VENUS (or Mercury) over the SUN'S DISK.

(Suppose that which happened June 5th, 17 H. 55 M. or the 6th Day, 55 M. past 5, in the Morning, 1761, with $4'.15''$ South Latitude).

FROM any Scale of equal Parts, take off, with a Pair of Dividers, $15'.50''$. = the Semidiameter of the Sun, and draw the Circle ABDE, which will represent the Sun's visible Disk.—Through the Center C draw the Line AD, to represent the *Ecliptic*, and cross it in the Middle with the other EB, for the Axis of the *Ecliptic*.—Then with a *Protractor*, or Line of Chords, set off the Angle of $8^\circ.28'$. = the Angle of the *visible Way* of *Venus* from B towards F, because that Planet is retrograde, and Latitude Ascending, or Increasing South; and draw CF for the Axis of *Venus's Way*.—Take the Latitude $4'.15''$. at the Time of that *Conjunction*, from the same Scale of equal Parts, and set it on the Axis of the *Ecliptic* from C to G, and draw HI through the Point G, at Right Angles to CF; so will HI describe the visible Path of *Venus* over the Sun.

And as the longest Time of any *Transit* of *Venus* is when she passes over the Middle of the Sun at AD, which is performed in $7^h.56'$. or eight Hours nearly, you have, by dividing the Diameter into eight equal Parts, the Space that *Venus* describes upon the Disk in one Hour.—And as the Middle of this *Transit*, at K, happens at 55' past 5, --take off 5' from one of the Hours, which you have previously divided into 60 equal Parts, and set them



from K towards G; that will show where *Venus* will be upon the Disk at 6 o'Clock.—Next, take off the Length of one whole Hour, and set it from 6, each Way along the Path HI. By this Means you will obtain the Hours both before and after 6; which number'd as in the Scheme, will shew the Time of the Beginning of the *Transit* at H, and the End at I.—You may draw little Circles upon the Path, to represent *Venus* upon the Disk. Her Diameter is about $1' 15''$, which is equal to one of the Divisions of the Scale of equal Parts by which you projected the Disk of the Sun.

The Path at the upper Part of the Sun represents the *Transit* of *Venus* which happened 1769, June 3 D. 10 H. 57 M. with $15'.43''$. North Lat. Descending.—These are all the *Transits* of this Planet within this Century.

* * * These Calculations and Projections are according to the *mean Motions* and *mean Latitudes* of those Planets, and may differ some little from the *true Time*; but will serve to illustrate and explain to the young Astronomer the Nature and Manner of a *Transit*, and enable him better to understand the Calculations from the exactest *Astronomical Tables*.

In all *Transits* at the *Descending Node* the Planets pass over the Sun *descending*, and at the *Ascending Node* they pass the Disk *ascending*. To

To find the Times of the OPPOSITIONS and CONJUNCTIONS of the Primary PLANETS.

SUPPOSE the Earth in *Conjunction*, &c. with any of the Superior Planets, *Mars*, *Jupiter*, or *Saturn*; then because the Earth revolves with a quicker Motion in her Orbit than either of those Planets, she will every Day recede from them, so much as is the *Difference* of their *Motions*; and when she has performed her Period, she will not come up with them again, because they have advanced with their Motion at the same Time: The Earth therefore must go on still further to overtake those Planets, and come to a *Conjunction* again: And to find how much, *say by the Rule of Proportion*——

As the *Difference* between the *Earth's* and *Planet's* Motion for any Time, suppose for *one Day*: — Is to *that Time*: : — So are 360° , the *whole Circle*: — To the *Time* they meet again.

By comparing the daily *Motions* of the *Earth* and the other *Planets* inserted in the foregoing Table at Page the 10th, and making the above Proportions; we find the Time between two *Conjunctions* of the *Earth* and *Saturn* to be 378 Days, or 1 Year and 13 Days — Between two *Conjunctions* of the *Earth* and *Jupiter*, 398 Days, or 1 Year and 33 Days. — Between two *Conjunctions* of the *Earth* and *Mars*, 2 Years and 50 Days. — Between two of the *Earth* and *Venus* of the same Kind*, 1 Year and 218 Days. — And between two of the *Earth* and *Mercury* of the same Kind, 115 Days.

There is the same Time between two *Conjunctions* of the *Planets* with the *Sun*; or between any other two similar *Aspects* with Him. — And the Time between the *Opposition* and *Conjunction* of a *Planet* with the *Sun* is equal to *half* the Time of their *Conjunctions* specified above.

The Times of these *Conjunctions* added to the former *Conjunction* found in any Almanack, &c. will give the Time of the next *Conjunction* following. — But as these *Periods* are computed according to their *mean Motions*, i. e. supposing them to move always in circular Orbits, (whereas they move in elliptical ones, moving sometimes a *little faster*, and sometimes a *little slower*;) it may happen that the *true Conjunctions* may fall a Day or two sooner or later than by the Calculation here given: But the true Time will be always shewn by the *Instrument*.

* By two *Conjunctions* of the same Kind in *Venus* and *Mercury* is meant two *Conjunctions* either in the *superior*, or two *Conjunctions* in the *inferior* Parts of their Orbits. — Every *Conjunction* of *Venus* is made about 9 *Signs* further in the *Ecliptic*, and *Mercury* about 4 *Signs*; but the Time in *Mercury* is a little uncertain on Account of his great *Eccentricity*.

Of the *Direct*, *Stationary*, and *Retrograde Appearances* of the Primary PLANETS.

THE *Stations* and *Retrogradations* of the *Planets* in the Heavens are not *real*, but *apparent* only, being caus'd by the Revolution of the Earth, and the various Positions of it in its Orbit, as was shewn before in treating of that Planet; and therefore it becomes unnecessary to repeat it here.

Tho' it is difficult to determine the exact Times of these Appearances by Calculation, yet the Instrument will shew them at all Times.—For if the *Index* when laid from the *Planet's* Place in its Orbit to the Earth touches the Earth's Orb, that *Planet* appears *stationary* in the Heavens at that Time. But if the *Index* cuts the Earth's Orbit, and the *Earth* and *Planet* are on opposite Sides the *Sun*, the Planet is then *direct*; but if both of them are on the same Side, the Planet is then *retrograde*.

To estimate nearly the Times of the *Directions*, *Stations*, and *Retrogradations*, &c. of the *Planets*, I have here subjoined the following Table, which the young *Astronomer* will find of much Use to him, in understanding and ascertaining these *Appearances*.

The Planets.	From one Conjunction, Station, and Retrogradation to another.	Days Direct.	Days Retrograde.	Degrees Retrograde.
Saturn	1 ^y : 13 ^d	238	140	7
Jupiter	1 : 33	279	120	10
Mars	2 : 50	700	80	20 15 10*
Venus	1 : 218	542	42	18
Mercury	0 : 115	92	24	16 8½

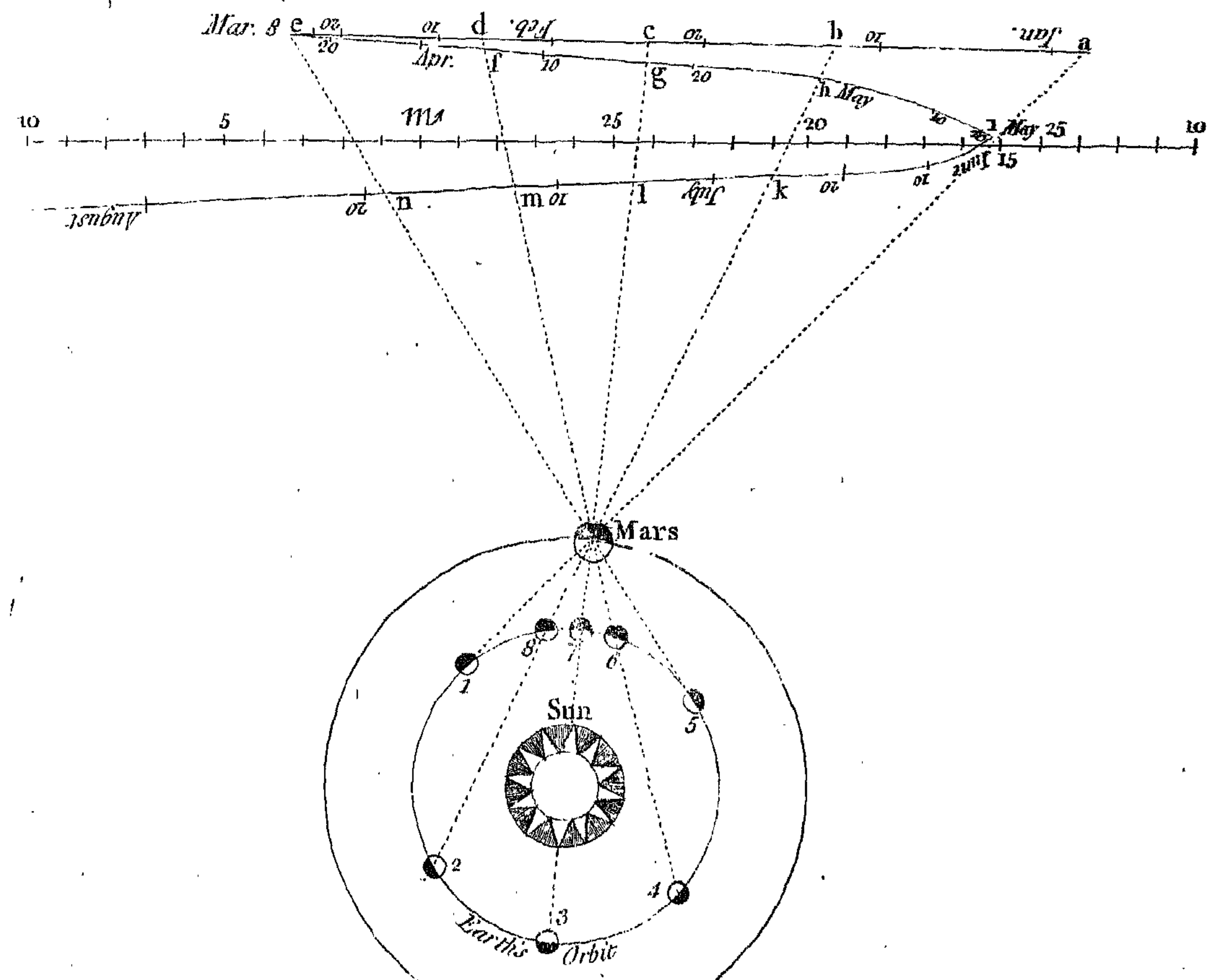
This Table is so clear and evident that it needs no Explanation: For you see that *Saturn* after 1 Year and 13 Days returns to the same Aspect with the *Earth* (or *Sun*);—continues *direct* in Motion 238 Days;—then runs *retrograde* 140 Days;—and goes back 7 Degrees in the *Ecliptic* †.

A *Planet* in his *retrograde Motion* does not describe exactly the Tract back again which he passed through in his *direct Motion*, because the *Latitude* is continually altering as seen from the Earth; so that sometimes he may pass a little above the *Ecliptic* Line; sometimes a little below it.—To explain this more fully, I shall here subjoin the *direct* and *retrograde Course* of the *Planet*

* *Mars* and *Mercury* are variable in their *Retrogradations* on Account of the great *Eccentricity* of their Orbits.

† *Fromondus*, who was averse to the annual Motion of the *Earth*, was obliged to confess that, that Motion was maintained by the *Copernicans* by no Argument more probable and specious than that of the *Station*, *Direction*, and *Retrogradation* of the *Planets*.—Whiston's Lectures, p. 203.

Mars, which he took in the Year 1762, and also the Place where it was *stationary*; by which the Learner will be enabled to understand those Appearances the better.



In this Scheme, the Center represents the *Sun*; the inner Circle the Orbit of the *Earth*, the other the Orbit of *Mars*.—The *Earth* being at 1, *Mars* is seen among the *fixed Stars* at a.—When the *Earth* is at 2, *Mars* is seen at b. When the *Earth* is come to 3, 4, and 5, *Mars* appears at c, d, and e.—Thus from a to e *Mars* moves *direct*, i. e. from *West* to *East* in the Heavens.—But the *Earth* being at 5, *Mars* is seen at e to be *stationary*, or at a Stand, for a few Days.—As the *Earth* moves from 5 to 6, *Mars* is seen to return in a *retrograde* Direction from e to f.—The *Earth* going on from 6, to 7, 8, and 1, *Mars* still proceeds to go *retrograde* from f, to g, h, and i.—At i *Mars* appears *stationary* again for a few Days.—The *Earth* removing from 1, to 2, 3, 4, and 5, *Mars* is seen to recover his *direct* Motion again, and to remove from i, to k, l, m, and n.

I have supposed *Mars* in this Projection to remain fixed in the same Place of his Orbit, in order to render the *direct* and *retrograde* Appearances evident to the *Pupil*; tho' it is certain he advances in his Orb the same Way, and at the same Time; but it would be very difficult to express in a Drawing that *compound Motion*. But the *direct* and *retrograde* Lines at the Top, to which the Months are affixed, is the apparent Tract which that *Planet* described in 1762. and the *dotted* Line is a Portion of the *Zodiac* it passed thro' in that Time.—At the End of the preceding Year *Mars* was observed at a, in about 14° of *Libra*, with 2° of North Lat. from whence he proceeded *direct* thro' the Months *January*, *February*, and to the 8th of *March*; when he became *stationary* in about $3^{\circ} 3'$ of *Scorpio*, with $2^{\circ} 32'$ North Lat.—Thro' the Remainder of *March*, *April*, and to the 25th of *May*, he proceeded *retrograde*, his Latitude *decreasing*, at which Time he became *stationary* again in about 15° of *Libra*.—From hence he began to move *direct* again, cross'd the *Ecliptic* Line in about $15^{\circ} 10'$ of *Libra*, and went on thro' *June*, *July*, *August*, &c. with South Lat. to the End of the Year.

To

To determine the greatest *Elongations* of the EARTH from the SUN, as beheld from any of the *Superior Planets*; and also, the greatest *Elongations* of the *Inferiors* from the SUN as seen from the EARTH.

BRING a Thread from the *Sun* across the *Instrument*, so as to cut the Orbits of all the *Planets*;---then lay the *Index* from the Intersections of the Thread with the Orbits of the *superior Planets* to the outer Part of the *Earth's* Orbit; and the several *Angles* measured at the *Planets* with a *Protractor*, (or by bringing another Thread *parallel* to the *Index*) will point out the greatest *Elongation* of the *Earth* to each of these *Planets*:—And which you will find to be at *Saturn* about 6 Degrees:—At *Jupiter* about 11 Degrees:—At *Mars* about 42 Degrees.——But for *Venus* and *Mercury*, lay the *Index* from the Intersection of the Thread with the *Earth's* Orbit to the Edge of their Orbits, and measure in like Manner the *Angle* at the *Earth*, and you'll have for the *Elongation* of *Venus* about 46 Degrees;---and *Mercury* about 22 Degrees*.

As these *Elongations* of *Venus* and *Mercury* are the greatest Distances these two Planets ever appear from the *Sun*, either before or after him; so the above *Elongations* of the *Earth* from the *Sun* is the greatest Distance that ever she appears to those Planets from him.——At *Mars* the *Earth* will never be seen to go farther from the *Sun* than about 42 Degrees, which is not so far as *Venus* is seen to do to us.——At *Jupiter* the Distance of the *Earth* will never be more than 11 Degrees from the *Sun*, which is *but half* the Distance that *Mercury* is found to be at here from the *Sun*; consequently a Sight of the *Earth*, even to them, must be a very rare and unusual *Phænomenon*.——And at *Saturn* the *Earth* can never be found to be more than 6 Degrees from the *Sun*; which Distance is not above *one fourth* of what we observe in *Mercury*: And as *Mercury* is seldom seen here, it is very probable that the *Earth* can never be seen there; and that the *Saturnian Astronomers* (if any) have not discovered that there is such a *Planet* or *World* as our *Earth* in the *System*.

* *Mercury*, on Account of the great Eccentricity of his Orbit, will have very different *Elongations*:—Sometimes it will be about 27 Degrees, at other Times not more than 17 Degrees.——But the *Elongations* in the other Planets will seldom differ more than 1 Degree.



N E W
ASTRONOMICAL TABLES:

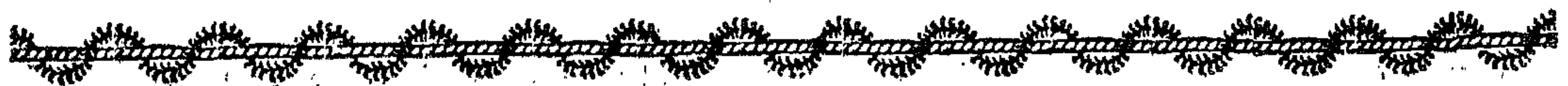
S H E W I N G,

The Mean ANOMALIES of all the
Primary PLANETS,

W I T H T H E

E Q U A T I O N S of their O R B I T S ;

By which their True DISTANCES from their APHELIONS may
be easily ascertained at any Time.



K.

N E W

NEW TABLES,

Shewing the Mean ANOMALIES of all the Primary Planets (or their Distance from their Aphelion Points), in *Years* of Christ current, adapted to the *New Style*.

These Numbers correspond to the Old Style.						
Years of Christ.	Mercury ☿	Venus ♀	Earth ☾	Mars ♂	Jupiter ♃	Saturn ♄
1681	7 19 40	1 29 53	6 13 11	11 19 55	8 0 41	6 18 45
1701	8 4 11	8 3 25	6 12 59	7 7 52	4 7 34	2 22 55
1721	8 18 42	8 6 56	6 12 47	2 25 49	0 14 28	10 27 6
1741	9 3 13	8 10 28	6 12 35	10 13 46	8 21 21	7 1 16
The following Numbers agree to the <i>New Style</i> , which commenced September the 2d, 1752.						
1761	8 2 43	1 26 22	6 1 34	5 25 57	4 27 20	3 5 5
1781	8 17 14	7 29 54	6 1 22	1 13 54	1 4 14	11 9 15
1801	8 27 40	2 1 48	6 0 9	9 1 20	9 11 2	7 13 24
1821	9 12 10	8 5 20	5 29 57	4 19 18	5 17 56	3 17 34
1841	9 26 41	2 8 52	5 29 45	0 7 16	1 24 50	11 21 44
1861	10 11 12	8 12 24	5 29 33	7 25 14	10 1 44	7 25 45

A TABLE of the Mean ANOMALIES of all the Primary Planets in *Months*.

Months.	Mercury ☿	Venus ♀	Earth ☾	Mars ♂	Jupiter ♃	Saturn ♄
January -	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0	0 0 0
February - -	4 6 52	1 19 40	1 0 33	9 16 15	0 2 35	0 1 2
March - - -	8 1 27	3 4 32	1 28 9	1 0 55	0 4 54	0 1 58
April - - -	0 8 19	4 24 11	2 28 42	1 17 10	0 7 29	0 3 1
May - - -	4 11 5	6 15 15	3 28 16	2 2 53	0 9 58	0 4 1
June - - -	8 17 57	8 1 55	4 28 50	2 19 8	0 12 33	0 5 3
July - - -	0 20 43	9 19 59	5 28 24	3 4 51	0 15 2	0 6 3
August - - -	4 27 34	11 9 39	6 28 57	3 21 6	0 17 37	0 7 5
September -	9 4 26	0 29 19	7 29 30	4 7 20	0 20 11	0 8 8
October -	1 7 12	2 17 23	8 29 4	4 23 4	0 22 41	0 9 8
November -	5 14 4	4 7 3	9 29 37	5 9 18	0 25 16	0 10 10
December -	9 16 50	5 21 7	10 29 11	5 25 2	0 27 43	0 11 11

☞ In *Leap Years*, after *February*, remember to take the Motion of one Day more.

A T A B L E

Of the Mean ANOMALIES of all the Primary Planets in *Years compleat*.

Years. compleat	Mercury ♿	Venus ♀	Earth ⊖	Mars ♂	Jupiter ♃	Saturn ♄
1	1 23 42	7 14 47	11 29 44	6 11 16	1 0 9	0 12 12
2	3 17 24	2 29 33	11 29 29	0 22 32	2 0 39	0 24 24
3	5 11 6	10 14 20	11 29 14	7 3 48	3 0 58	1 6 36
4	7 8 54	6 0 43	11 29 58	1 15 35	4 1 23	1 18 50
5	9 2 36	1 15 29	11 29 42	7 26 51	5 1 42	2 1 2
6	10 26 19	9 0 15	11 29 27	2 8 7	6 2 2	2 15 14
7	0 20 0	4 15 2	11 29 11	8 19 23	7 2 21	2 25 26
8	2 17 48	0 1 25	11 29 55	3 1 11	8 2 45	3 7 40
9	4 11 31	7 16 11	11 29 40	9 12 27	9 3 5	3 19 52
10	6 5 13	3 0 58	11 29 24	3 23 43	10 3 24	4 2 4
11	7 28 55	10 15 41	11 29 9	10 4 59	11 3 46	4 4 16
12	9 26 42	6 2 7	11 29 53	4 16 46	0 4 8	4 26 30
13	11 20 25	1 16 54	11 29 37	10 28 2	1 4 28	5 8 42
14	1 14 7	9 1 40	11 29 22	5 9 18	2 4 47	5 20 54
15	3 7 47	4 12 27	11 29 7	11 20 34	3 5 6	6 3 6
16	5 5 37	0 2 49	11 29 50	6 2 22	4 5 31	6 15 20
17	6 29 19	7 17 36	11 29 55	0 13 38	5 5 50	6 27 32
18	8 23 1	3 2 22	11 29 20	6 24 54	6 6 10	7 9 44
19	10 16 43	10 17 9	11 29 4	1 6 10	7 6 29	7 24 56
20	0 14 31	6 3 32	11 29 48	7 17 58	8 6 54	8 4 10
40	0 29 2	0 7 3	11 29 36	3 5 54	4 13 47	4 8 21
60	1 13 33	6 10 25	11 29 24	10 23 51	0 20 41	0 12 32
80	1 28 3	0 14 6	11 29 12	6 11 49	8 27 35	8 16 42
100	2 12 34	6 17 28	11 29 0	1 29 46	15 4 28	4 20 52

A T A B L E

A T A B L E

Of the Mean ANOMALIES of all the Planets in
Days.

Days	♈	♉	♊	♋	♌	♍
1	0 4 6	0 1 36	0 0 59	0 31	0 5	0 2
2	0 8 11	0 3 12	0 1 58	1 3	0 10	0 4
3	0 12 17	0 4 48	0 2 57	1 3	0 15	0 6
4	0 16 22	0 6 25	0 3 57	2 6	0 20	0 8
5	0 20 28	0 8 1	0 4 56	2 37	0 25	0 10
6	0 24 33	0 9 37	0 5 55	3 9	0 30	0 12
7	0 28 39	0 11 13	0 6 54	3 40	0 35	0 14
8	1 2 44	0 12 49	0 7 53	4 12	0 40	0 16
9	1 6 50	0 14 25	0 8 52	4 43	0 45	0 18
10	1 10 55	0 16 1	0 9 51	5 14	0 50	0 20
11	1 15 1	0 17 37	0 10 50	5 46	0 55	0 22
12	1 19 6	0 19 14	0 11 50	6 17	1 0	0 24
13	1 23 12	0 20 50	0 12 49	6 49	1 5	0 26
14	1 27 18	0 22 26	0 13 48	7 20	1 10	0 28
15	2 1 23	0 24 2	0 14 47	7 52	1 15	0 30
16	2 5 29	0 25 38	0 15 46	8 23	1 20	0 32
17	2 9 34	0 27 14	0 16 45	8 55	1 25	0 34
18	2 13 40	0 28 50	0 17 44	9 26	1 30	0 36
19	2 17 45	1 0 26	0 18 44	9 57	1 35	0 38
20	2 21 51	1 2 2	0 19 43	10 29	1 40	0 40
21	2 25 56	1 3 39	0 20 42	11 0	1 45	0 42
22	3 0 2	1 5 15	0 21 41	11 32	1 50	0 44
23	3 4 7	1 6 51	0 22 40	12 3	1 55	0 46
24	3 8 13	1 8 27	0 23 37	12 35	2 0	0 48
25	3 12 18	1 10 3	0 24 38	13 6	2 5	0 50
26	3 16 24	1 11 39	0 25 38	13 37	2 10	0 52
27	3 20 30	1 13 15	0 26 37	14 9	2 15	0 54
28	3 24 35	1 14 52	0 27 36	14 40	2 20	0 56
29	3 28 41	1 16 28	0 28 34	15 12	2 25	0 58
30	4 2 46	1 18 4	0 29 34	15 43	2 30	1 0
31	4 6 52	1 19 40	1 0 33	16 15	2 35	1 2
32	4 10 57	1 21 16	1 1 32	16 46	2 40	1 4

✿ In Leap Year, after February, remember to add the Motion of a Day more.

A T A B L E

Of the Mean ANOMALIES of all the Planets in
Hours.

	♈	♉	♊	♋	♌	♍
1	0 10	0 4	0 2	0 1	0 0	0 0
2	0 20	0 8	0 5	0 3	0 0	0 0
3	0 31	0 12	0 7	0 4	0 1	0 0
4	0 42	0 16	0 10	0 5	0 1	0 0
5	0 51	0 20	0 12	0 7	0 1	0 0
6	1 1	0 24	0 15	0 8	0 1	0 0
7	1 12	0 28	0 17	0 9	0 1	0 1
8	1 22	0 32	0 20	0 10	0 2	0 1
9	1 32	0 36	0 22	0 12	0 2	0 1
10	1 42	0 40	0 25	0 13	0 2	0 1
11	1 53	0 44	0 27	0 14	0 2	0 1
12	2 3	0 48	0 30	0 16	0 2	0 1
13	2 13	0 52	0 32	0 17	0 3	0 1
14	2 23	0 56	0 34	0 18	0 3	0 1
15	2 34	1 0	0 37	0 20	0 3	0 1
16	2 44	1 4	0 39	0 21	0 3	0 1
17	2 54	1 8	0 43	0 22	0 4	0 1
18	3 4	1 12	0 44	0 24	0 4	0 1
19	3 14	1 16	0 47	0 25	0 4	0 2
20	3 25	1 20	0 49	0 26	0 4	0 2
21	3 35	1 24	0 52	0 27	0 4	0 2
22	3 45	1 28	0 54	0 29	0 5	0 2
23	3 55	1 32	0 57	0 30	0 5	0 2
24	4 5	1 36	0 59	0 31	0 5	0 2

The ANOMALIES of the Planets in *Minutes.*

	D. M.	D. M.	D. M.	D. M.	D. M.	D. M.
10	0 2	0 1	0 0	0 0	0 0	0 0
20	0 3	0 1	0 1	0 0	0 0	0 0
30	0 5	0 2	0 1	0 1	0 0	0 0
40	0 7	0 3	0 2	0 1	0 0	0 0
50	0 8	0 3	0 2	0 1	0 0	0 0
60	0 10	0 4	0 2	0 1	0 0	0 0

The EQUATION

Of MERCURY'S ORBIT.

Mercury's Mean Anomaly	Subtracted from the Mean Anomaly gives the True.						Mean Anomaly
	0 Sign	1 Sign	2 Sign	3 Sign	4 Sign	5 Sign	
	D. M.	D. M.	D. M.	D. M.	D. M.	D. M.	
0	0 0	9 35	17 48	22 57	22 48	14 57	30
1	0 19	9 53	18 2	23 3	22 40	14 32	29
2	0 39	10 11	18 16	23 8	22 32	14 8	28
3	0 58	10 30	18 29	23 13	22 23	13 42	27
4	1 18	10 48	18 42	23 18	22 14	13 16	26
5	1 38	11 5	18 56	23 22	22 4	12 50	25
6	1 57	11 23	19 8	23 26	21 54	12 23	24
7	2 17	11 41	19 21	23 29	21 43	11 56	23
8	2 36	11 58	19 33	23 32	21 31	11 28	22
9	2 56	12 16	19 46	23 35	21 19	11 0	21
10	3 15	12 33	19 57	23 37	21 7	10 32	20
11	3 35	12 50	20 9	23 39	20 54	10 3	19
12	3 54	13 7	20 21	23 40	20 40	9 34	18
13	4 14	13 24	20 32	23 41	20 26	9 4	17
14	4 33	13 41	20 43	23 42	20 11	8 34	16
15	4 52	13 58	20 54	23 42	19 56	8 3	15
16	5 12	14 14	21 4	23 42	19 40	7 33	14
17	5 31	14 30	21 13	23 41	19 23	7 2	13
18	5 50	14 47	21 23	23 40	19 2	6 30	12
19	6 9	15 3	21 33	23 38	18 48	5 59	11
20	6 28	15 19	21 42	23 36	18 30	5 27	10
21	6 47	15 34	21 51	23 35	18 11	4 55	9
22	7 6	15 50	22 0	23 30	17 52	4 22	8
23	7 25	16 5	22 8	23 27	17 32	3 50	7
24	7 44	16 20	22 16	23 23	17 11	3 17	6
25	8 3	16 39	22 24	23 18	16 50	2 45	5
26	8 22	16 50	22 31	23 13	16 29	2 12	4
27	8 40	17 5	22 38	23 7	16 6	1 39	3
28	8 58	17 20	22 45	23 1	15 44	1 6	2
29	9 17	17 34	22 51	22 55	15 21	0 33	1
30	9 25	17 48	22 57	22 48	14 57	0 0	0
	11 Sign	10 Sign	9 Sign	8 Sign	7 Sign	6 Sign	
Add to the Mean Anomaly gives the True.							

The

EQUATION

Of VENUS' ORBIT.

Venus' Mean Anomaly	Subtracted from the Mean Anomaly gives the True.						Mean Anomaly
	0 Sign	1 Sign	2 Sign	3 Sign	4 Sign	5 Sign	
	D. M.	D. M.	D. M.	D. M.	D. M.	D. M.	
0	0 0	0 23	0 41	0 48	0 41	0 24	30
1	0 0	0 24	0 41	0 48	0 41	0 23	29
2	0 1	0 25	0 42	0 47	0 40	0 22	28
3	0 2	0 25	0 42	0 47	0 40	0 21	27
4	0 3	0 26	0 42	0 47	0 39	0 21	26
5	0 4	0 27	0 43	0 47	0 39	0 20	25
6	0 4	0 28	0 43	0 47	0 39	0 19	24
7	0 5	0 28	0 44	0 47	0 38	0 18	23
8	0 6	0 29	0 44	0 47	0 38	0 18	22
9	0 7	0 30	0 44	0 47	0 37	0 17	21
10	0 8	0 30	0 44	0 47	0 36	0 16	20
11	0 9	0 31	0 45	0 47	0 36	0 15	19
12	0 9	0 31	0 45	0 47	0 35	0 14	18
13	0 10	0 32	0 45	0 46	0 35	0 14	17
14	0 11	0 33	0 46	0 46	0 34	0 13	16
15	0 12	0 33	0 46	0 46	0 34	0 12	15
16	0 13	0 34	0 46	0 46	0 33	0 11	14
17	0 13	0 34	0 46	0 46	0 32	0 10	13
18	0 14	0 35	0 46	0 45	0 32	0 10	12
19	0 15	0 36	0 47	0 45	0 31	0 9	11
20	0 16	0 36	0 47	0 45	0 31	0 8	10
21	0 17	0 37	0 47	0 44	0 30	0 7	9
22	0 17	0 37	0 47	0 44	0 29	0 6	8
23	0 18	0 38	0 47	0 44	0 29	0 5	7
24	0 19	0 38	0 47	0 43	0 28	0 5	6
25	0 20	0 39	0 47	0 43	0 27	0 4	5
26	0 20	0 39	0 47	0 43	0 27	0 3	4
27	0 21	0 40	0 47	0 42	0 26	0 2	3
28	0 22	0 40	0 47	0 42	0 25	0 1	2
29	0 23	0 40	0 47	0 42	0 24	0 0	1
30	0 23	0 41	0 48	0 41	0 24	0 0	0
	11 Sign	10 Sign	9 Sign	8 Sign	7 Sign	6 Sign	
Add to the Mean Anomaly gives the True.							

The EQUATION

Of the EARTH'S ORBIT.

Earth's Mean Anomaly	<i>Subtracted from the Mean Anomaly gives the True.</i>						Mean Anomaly
	0 Sign	1 Sign	2 Sign	3 Sign	4 Sign	5 Sign	
	D. M.	D. M.	D. M.	D. M.	D. M.	D. M.	
0	0 0	0 56	1 39	1 56	1 41	0 59	30
1	0 1	0 58	1 40	1 56	1 40	0 57	29
2	0 3	1 0	1 41	1 56	1 39	0 55	28
3	0 5	1 2	1 42	1 56	1 38	0 53	27
4	0 7	1 3	1 43	1 56	1 37	0 51	26
5	0 9	1 5	1 44	1 56	1 36	0 49	25
6	0 11	1 7	1 45	1 55	1 35	0 48	24
7	0 13	1 8	1 45	1 55	1 33	0 46	23
8	0 15	1 10	1 46	1 55	1 32	0 44	22
9	0 17	1 11	1 47	1 55	1 31	0 42	21
10	0 19	1 13	1 48	1 55	1 30	0 40	20
11	0 21	1 14	1 49	1 54	1 28	0 38	19
12	0 23	1 16	1 49	1 54	1 27	0 36	18
13	0 25	1 17	1 50	1 53	1 26	0 34	17
14	0 27	1 19	1 50	1 53	1 24	0 32	16
15	0 29	1 20	1 51	1 52	1 23	0 30	15
16	0 31	1 22	1 52	1 52	1 21	0 28	14
17	0 33	1 23	1 52	1 51	1 20	0 26	13
18	0 35	1 25	1 52	1 51	1 18	0 24	12
19	0 37	1 26	1 53	1 50	1 17	0 22	11
20	0 38	1 27	1 53	1 49	1 15	0 20	10
21	0 40	1 28	1 54	1 49	1 14	0 18	9
22	0 42	1 30	1 54	1 48	1 12	0 16	8
23	0 44	1 31	1 55	1 47	1 10	0 14	7
24	0 46	1 32	1 55	1 46	1 9	0 12	6
25	0 48	1 33	1 55	1 46	1 7	0 10	5
26	0 49	1 35	1 55	1 45	1 5	0 8	4
27	0 51	1 36	1 55	1 44	1 4	0 6	3
28	0 53	1 37	1 56	1 43	1 2	0 4	2
29	0 55	1 38	1 56	1 42	1 0	0 2	1
30	0 56	1 39	1 56	1 41	0 59	0 0	0
	11 Sign	10 Sign	9 Sign	8 Sign	7 Sign	6 Sign	
<i>Add to the Mean Anomaly gives the True.</i>							

The EQUATION
Of MARS'S ORBIT.

Mean Anomaly Mars's	Subtracted from the Mean Anomaly gives the True.						Mean Anomaly
	0 Sign	1 Sign	2 Sign	3 Sign	4 Sign	5 Sign	
	D. M.	D. M.	D. M.	D. M.	D. M.	D. M.	
0	0 0	4 50	8 41	10 35	9 44	5 54	30
1	0 10	4 59	8 47	10 36	9 40	5 44	29
2	0 19	5 7	8 53	10 37	9 35	5 33	28
3	0 29	5 16	8 58	10 38	9 29	5 23	27
4	0 39	5 25	9 4	10 39	9 24	5 12	26
5	0 49	5 34	9 9	10 39	9 18	5 1	25
6	0 59	5 42	9 15	10 40	9 12	4 50	24
7	1 9	5 51	9 20	10 40	9 6	4 39	23
8	1 19	5 59	9 25	10 39	9 0	4 28	22
9	1 29	6 8	9 30	10 39	8 53	4 16	21
10	1 39	6 16	9 35	10 38	8 47	4 5	20
11	1 49	6 24	9 39	10 38	8 40	3 53	19
12	1 59	6 32	9 44	10 37	8 33	3 41	18
13	2 9	6 40	9 48	10 36	8 25	3 30	17
14	2 18	6 48	9 52	10 34	8 18	3 18	16
15	2 28	6 56	9 56	10 33	8 10	3 6	15
16	2 38	7 4	10 0	10 31	8 2	2 54	14
17	2 48	7 12	10 4	10 29	7 54	2 42	13
18	2 58	7 19	10 7	10 27	7 46	2 29	12
19	3 7	7 27	10 10	10 24	7 38	2 17	11
20	3 16	7 34	10 13	10 22	7 29	2 5	10
21	3 26	7 41	10 16	10 19	7 20	1 52	9
22	3 36	7 48	10 19	10 16	7 12	1 40	8
23	3 45	7 55	10 22	10 13	7 2	1 28	7
24	3 54	8 2	10 24	10 9	6 53	1 15	6
25	4 4	8 9	10 27	10 6	6 44	1 3	5
26	4 13	8 15	10 29	10 2	6 34	0 50	4
27	4 22	8 22	10 31	9 58	6 24	0 37	3
28	4 31	8 28	10 32	9 54	6 14	0 25	2
29	4 40	8 35	10 34	9 49	6 4	0 12	1
30	4 50	8 41	10 35	9 44	5 54	0 0	0
	11 Sign	10 Sign	9 Sign	8 Sign	7 Sign	6 Sign	
Add to the Mean Anomaly gives the True.							

The EQUATION Of JUPITER'S ORBIT.

Jupiter's Mean Anomaly	Subtracted from the Mean Anomaly gives the True.						Mean Anomaly
	0 Sign	1 Sign	2 Sign	3 Sign	4 Sign	5 Sign	
	D. M.	D. M.	D. M.	D. M.	D. M.	D. M.	
0	0 0	2 37	4 38	5 31	4 55	2 54	30
1	0 5	2 42	4 41	5 31	4 52	2 49	29
2	0 10	2 47	4 44	5 31	4 50	2 44	28
3	0 16	2 51	4 47	5 31	4 47	2 39	27
4	0 21	2 56	4 49	5 31	4 44	2 33	26
5	0 27	3 1	4 52	5 31	4 40	2 28	25
6	0 32	3 5	4 55	5 31	4 37	2 22	24
7	0 38	3 10	5 57	5 31	4 34	2 17	23
8	0 43	3 14	5 0	5 30	4 31	2 11	22
9	0 48	3 19	5 2	5 30	4 27	2 5	21
10	0 54	3 23	5 4	5 29	4 23	2 0	20
11	0 59	3 27	5 7	5 28	4 20	1 54	19
12	1 5	3 32	5 9	5 27	4 16	1 48	18
13	1 10	3 36	5 11	5 27	4 12	1 42	17
14	1 15	3 40	5 13	5 25	4 8	1 37	16
15	1 21	3 44	5 14	5 24	4 4	1 31	15
16	1 26	3 48	5 16	5 23	4 0	1 25	14
17	1 31	3 52	5 18	5 22	3 56	1 19	13
18	1 36	3 56	5 19	5 20	3 54	1 13	12
19	1 42	4 0	5 21	5 19	3 47	1 7	11
20	1 47	4 4	5 22	5 17	3 43	1 1	10
21	1 52	4 8	5 23	5 15	3 38	0 55	9
22	1 57	4 11	5 25	5 14	3 34	0 49	8
23	2 2	4 15	5 26	5 12	3 29	0 42	7
24	2 7	4 18	5 27	5 10	3 24	0 36	6
25	2 12	4 22	5 28	5 7	3 19	0 30	5
26	2 17	4 25	5 28	5 5	3 15	0 24	4
27	2 22	4 28	5 29	5 3	3 10	0 18	3
28	2 27	4 32	5 30	5 0	3 5	0 12	2
29	2 32	4 35	5 30	4 58	2 59	0 6	1
30	2 37	4 38	5 31	4 55	2 54	0 0	0
	11 Sign	10 Sign	9 Sign	8 Sign	7 Sign	6 Sign	
Add to the Mean Anomaly gives the True.							

The EQUATION

Of SATURN'S ORBIT.

Saturn's Mean Anomaly	<i>Subtracted from the Mean Anomaly gives the True.</i>						Mean Anomaly
	0 Sign	1 Sign	2 Sign	3 Sign	4 Sign	5 Sign	
	D. M.	D. M.	D. M.	D. M.	D. M.	D. M.	
0	0 0	3 4	5 27	6 31	5 51	3 28	30
1	0 6	3 10	5 30	6 31	5 48	3 22	29
2	0 12	3 15	5 34	6 31	5 44	3 16	28
3	0 19	3 21	5 37	6 32	5 41	3 9	27
4	0 25	3 26	5 41	6 52	5 37	3 3	26
5	0 31	3 32	5 44	6 32	5 34	2 56	25
6	0 38	3 37	5 47	6 31	5 30	2 50	24
7	0 44	3 42	5 50	6 31	5 26	2 43	23
8	0 50	3 48	5 53	6 31	5 22	2 37	22
9	0 57	3 53	5 56	6 30	5 18	2 30	21
10	1 3	3 58	5 58	6 29	5 14	2 23	20
11	1 9	4 3	6 1	6 29	5 9	2 16	19
12	1 16	4 8	6 4	6 28	5 5	2 9	18
13	1 22	4 13	6 6	6 27	5 0	2 2	17
14	1 28	4 18	6 8	6 26	4 56	1 55	16
15	1 34	4 23	6 11	6 24	4 51	1 48	15
16	1 41	4 28	6 13	6 23	4 46	1 41	14
17	1 47	4 33	6 15	6 21	4 41	1 34	13
18	1 53	4 37	6 17	6 20	4 46	1 27	12
19	1 59	4 42	6 18	6 18	4 31	1 20	11
20	2 7	4 46	6 20	6 16	4 26	1 13	10
21	2 11	4 51	6 22	6 15	4 20	1 5	9
22	2 17	4 55	6 23	6 12	4 15	0 58	8
23	2 23	4 59	6 24	6 10	4 9	0 51	7
24	2 29	5 3	6 26	6 8	4 4	0 44	6
25	2 30	5 8	6 27	6 5	3 58	0 36	5
26	2 41	5 12	6 28	6 2	3 52	0 29	4
27	2 47	5 15	6 29	6 0	3 46	0 22	3
28	2 53	5 19	6 29	5 57	3 40	0 14	2
29	2 58	5 23	6 30	5 54	3 34	0 7	1
30	3 4	5 27	6 31	5 51	3 28	0 0	0
	11 Sign	10 Sign	9 Sign	8 Sign	7 Sign	6 Sign	
<i>Add to the Mean Anomaly gives the True.</i>							

A T A B L E

Shewing the INCLINATIONS, or *Heliocentrick* Latitudes of all the Primary PLANETS, by having their Distance from the nearest *Node*.

Dist. from nearest <i>Node</i> in Degrees.	♈		♀		♂		♂		♂	
	D	M.	D	M.	D	M.	D	M.	D	M.
0	0	0	0	0	0	0	0	0	0	0
1	0	7	0	4	0	2	0	1	0	3
2	0	15	0	7	0	4	0	3	0	5
3	0	22	0	11	0	6	0	4	0	8
4	0	29	0	14	0	8	0	6	0	10
5	0	36	0	18	0	10	0	7	0	13
6	0	44	0	21	0	12	0	8	0	16
7	0	50	0	25	0	14	0	10	0	18
8	0	58	0	28	0	16	0	11	0	21
9	1	5	0	32	0	17	0	13	0	24
10	1	13	0	35	0	19	0	14	0	26
11	1	20	0	39	0	21	0	15	0	29
12	1	27	0	42	0	23	0	16	0	31
13	1	34	0	46	0	25	0	18	0	34
14	1	41	0	49	0	27	0	19	0	36
15	1	48	0	53	0	29	0	21	0	39
16	1	55	0	56	0	31	0	22	0	41
17	2	2	0	59	0	32	0	23	0	44
18	2	9	1	3	0	34	0	25	0	46
19	2	16	1	6	0	36	0	26	0	48
20	2	23	1	9	0	38	0	27	0	51
21	2	30	1	13	0	40	0	29	0	54
22	2	37	1	16	0	42	0	30	0	56
23	2	43	1	19	0	43	0	31	0	59
24	2	50	1	23	0	45	0	33	1	1
25	2	57	1	26	0	47	0	34	1	3
26	3	2	1	29	0	49	0	35	1	6
27	3	10	1	32	0	50	0	36	1	8
28	3	16	1	35	0	52	0	38	1	11
29	3	23	1	38	0	54	0	39	1	13
30	3	29	1	42	0	56	0	40	1	15

A T A B L E

Shewing the INCLINATIONS, or *Heliocentric* Latitudes of all the Primary PLANETS, by having their Distance from the nearest *Node*.

Dift. from nearest <i>Node</i> in Degrees.	♄	♀	♂	♃	♅
	D. M.	D. M.	D. M.	D. M.	D. M.
30	3 29	1 42	0 56	0 40	1 15
31	3 36	1 44	0 57	0 41	1 17
32	3 42	1 48	0 59	0 42	1 20
33	3 48	1 51	1 0	0 44	1 22
34	3 54	1 53	1 2	0 45	1 24
35	4 0	1 56	1 4	0 46	1 26
36	4 6	1 59	1 5	0 47	1 28
37	4 12	2 2	1 7	0 48	1 30
38	4 18	2 5	1 8	0 49	1 32
39	4 23	2 8	1 10	0 50	1 34
40	4 29	2 11	1 11	0 51	1 37
41	4 35	2 13	1 13	0 52	1 39
42	4 40	2 16	1 14	0 54	1 41
43	4 46	2 18	1 16	0 55	1 42
44	4 51	2 21	1 17	0 56	1 44
45	4 56	2 24	1 19	0 57	1 46
46	5 1	2 27	1 20	0 58	1 48
47	5 6	2 29	1 21	0 59	1 50
48	5 11	2 31	1 23	0 59	1 52
49	5 16	2 33	1 24	1 0	1 53
50	5 21	2 36	1 25	1 1	1 55
51	5 26	2 38	1 26	1 2	1 57
52	5 30	2 40	1 27	1 3	1 58
53	5 35	2 42	1 29	1 4	2 00
54	5 39	2 44	1 30	1 5	2 1
55	5 43	2 46	1 31	1 5	2 3
56	5 47	2 48	1 32	1 6	2 5
57	5 51	2 50	1 33	1 7	2 6
58	5 55	2 52	1 34	1 8	2 7
59	5 59	2 54	1 35	1 8	2 9
60	6 3	2 56	1 36	1 9	2 10

A T A B L E

Shewing the INCLINATIONS, or *Heliocentric* Latitudes of all the Primary PLANETS, by having their Distance from the nearest *Node*.

Dift. from nearest Node in Degrees.	♈	♉	♊	♋	♌
	D. M.	D. M.	D. M.	D. M.	D. M.
60	6 3	2 56	1 36	1 9	2 10
61	6 7	2 58	1 37	1 10	2 11
62	6 10	2 59	1 38	1 10	2 13
63	6 13	3 1	1 39	1 11	2 14
64	6 17	3 3	1 40	1 12	2 15
65	6 20	3 4	1 41	1 12	2 16
66	6 23	3 6	1 41	1 13	2 17
67	6 26	3 7	1 42	1 13	2 18
68	6 29	3 8	1 43	1 14	2 19
69	6 31	3 10	1 44	1 14	2 20
70	6 34	3 11	1 44	1 15	2 21
71	6 36	3 12	1 45	1 15	2 22
72	6 39	3 13	1 46	1 16	2 23
73	6 41	3 14	1 46	1 16	2 24
74	6 43	3 15	1 47	1 17	2 24
75	6 45	3 16	1 47	1 17	2 25
76	6 47	3 17	1 48	1 18	2 26
77	6 49	3 18	1 48	1 18	2 26
78	6 50	3 19	1 48	1 18	2 27
79	6 52	3 20	1 49	1 18	2 27
80	6 53	3 20	1 49	1 18	2 28
81	6 54	3 21	1 50	1 18	2 28
82	6 55	3 21	1 50	1 19	2 29
83	6 56	3 22	1 50	1 19	2 29
84	6 57	3 22	1 51	1 19	2 29
85	6 58	3 23	1 51	1 19	2 30
86	6 58	3 23	1 51	1 19	2 30
87	6 59	3 23	1 51	1 19	2 30
88	6 59	3 23	1 51	1 19	2 30
89	6 59	3 23	1 51	1 19	2 30
90	6 59	3 23	1 51	1 19	2 30

The foregoing Tables are adapted to the *New Style* *. The first Table, *i. e.* for the Years of Christ current, exhibits the Distances of the Planets from their *Aphelions* on the last Day at *Noon* of the preceeding Year. For from thence it is *Astronomers* begin their Year, (which holds true also of the Months and Days) and not from *Midnight* of the last Day, as the *civil* Year begins.—*Astronomers* likewise reckon on regularly through the twenty-four Hours, from the *Noon* of one Day to the *Noon* of the following Day. Thus, *January* 10th Day 18th Hour in the astronomical Accompt, answers to the 11th Day 6 o'Clock in the Morning of the common or vulgar Reckoning. This should be carefully minded, else you will be liable to commit great Mistakes.

It may be necessary further to observe, that because the *Aphelions* of the Planets have a slow progressive Motion in the *Ecliptic*, but on the *Instrument* are fixed to one particular Point; hence it will come to pass, that in an Age or two, the Places found by this Method will differ a few Minutes from their true Places in the Heavens †.—But then the

* The Numbers are adapted to the *New Style*, only to give the Learner less Trouble in reducing the Old Style to the New before he begins his Calculations, as all Tables are accommodated to that Kind of Reckoning.

† It has been doubted by many *Astronomers*, whether the *Aphelions* and *Nodes* of the Planets are moveable or not.—*Street*, *Whiston*, and even *Newton*, asserted that they are at Rest, with respect to the *fixed Stars*; and consequently, that they advanced only so much as is the *Recession* of the *Equinox* (backwards) *Copernicus*, I believe, with *Halley* and *Leadbetter*, made the *Aphelions* advance forward much faster, and with a Motion different to each other. The Stars seem to advance only 1 Degree in 72 Years; but *Saturn's Aphelion* (according to *Leadbetter*) proceeds 1 Degree in 45 Years: *Jupiter's*, 1 Degree in 50 Years: *Mars's*, 1 Degree in 51½ Years: *Venus's*, 1 Degree in 63 Years: and *Mercury's*, 1 Degree in 69 Years. And upon this Supposition the foregoing Tables of the Planets Distances from their *Aphelions* are constructed.—But if, at last, it should be proved that the *Aphelions* do not advance in their Orbs, but continue immoveable with respect to the *fixed Stars*, then it will be easy to project the *Instrument* in such Manner as shall make it *perpetual*; and it will become almost as useful as the large Volumes of Tables, in ascertaining the true Places and Situations of the *primary Planets* in all Ages from the Creation to the *Flood*,—to the Time of *Hesiod*,—to *Eudoxus*,—to *Aratus*,—to *Hypparchus*,—to *Ptolemy*,—to *Copernicus*,—to *Kepler*,—to *Newton*,—and to the End of the great *Platonic Year*.

Instrument

Instrument may be easily projected a new, by the Rules laid down in the former Part of the Book : And, though it should err a few Minutes, it will still have its Uses in pointing out the Situation of the Triangles made by the Lines in the Heavens at the Time of the Calculations, and thence evidently inform the Learner of the *true Theory* of the *System*; and by that Means make him Master of this fine Science; which is not so easily to be attained, perhaps, by any other Method.

✎ The SURVEY of the several SATELLITES attending the *Primary* Planets,——as that belonging to our *Earth*;—the Four of *Jupiter's*, and the Five of *Saturn's*; with the the Position of his *Ring* at all Times, will be exhibited in a future Work.

F I N I S.

